S. HRG. 100-849

# STATE MINING AND MINERAL RESOURCES RESEARCH INSTITUTE PROGRAM

## HEARING

BEFORE THE

SUBCOMMITTEE ON MINERAL RESOURCES DEVELOPMENT AND PRODUCTION

OF THE

## COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

SECOND SESSION

ON

## S. 2240

TO AMEND THE ACT TO REAUTHORIZE THE STATE MINING AND MINERAL RESOURCES RESEARCH INSTITUTE PROGRAM, AND FOR OTHER PURPOSES

JUNE 27, 1988

Printed for the use of the
Committee on Energy and Natural Resources

U.S. GOVERNMENT PRINTING OFFICE

90-486 WASHINGTON : 1988

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

S311-17 → 82

## COMMITTEE ON ENERGY AND NATURAL RESOURCES

J. BENNETT JOHNSTON, Louisiana, *Chairman*

| | |
|---|---|
| DALE BUMPERS, Arkansas | JAMES A. McCLURE, Idaho |
| WENDELL H. FORD, Kentucky | MARK O. HATFIELD, Oregon |
| HOWARD M. METZENBAUM, Ohio | LOWELL P. WEICKER, JR., Connecticut |
| JOHN MELCHER, Montana | PETE V. DOMENICI, New Mexico |
| BILL BRADLEY, New Jersey | MALCOLM WALLOP, Wyoming |
| JEFF BINGAMAN, New Mexico | FRANK H. MURKOWSKI, Alaska |
| TIMOTHY E. WIRTH, Colorado | DON NICKLES, Oklahoma |
| WYCHE FOWLER, JR., Georgia | CHIC HECHT, Nevada |
| KENT CONRAD, North Dakota | DANIEL J. EVANS, Washington |

DARYL H. OWENS, *Staff Director*
D. MICHAEL HARVEY, *Chief Counsel*
FRANK M. CUSHING, *Staff Director for the Minority*
GARY G. ELLSWORTH, *Chief Counsel for the Minority*

---

### SUBCOMMITTEE ON MINERAL RESOURCES DEVELOPMENT AND PRODUCTION

JOHN MELCHER, Montana, *Chairman*
TIMOTHY E. WIRTH, Colorado, *Vice Chairman*

| | |
|---|---|
| WENDELL H. FORD, Kentucky | CHIC HECHT, Nevada |
| JEFF BINGAMAN, New Mexico | DON NICKLES, Oklahoma |
| KENT CONRAD, North Dakota | MALCOLM WALLOP, Wyoming |
| | FRANK H. MURKOWSKI, Alaska |

J. BENNETT JOHNSTON and JAMES A. McCLURE are Ex Officio Members of the Subcommittee

PATRICIA J. BENEKE, *Senior Counsel*
LISA A. VEHMAS, *Professional Staff Member*

# CONTENTS


| | Page |
|---|---|
| S. 2240 | 3 |

STATEMENTS

| | |
|---|---|
| Bajura, Dr. Richard A., director, Energy and Water Research, West Virginia University, accompanied by George Fumich | 35 |
| Ford, Hon. Wendell H., U.S. Senator from Kentucky | 34 |
| Melcher, Hon. John, U.S. Senator from Montana | 1 |
| Morgan, Dr. John D., Chief Staff Officer, Bureau of Mines, Department of the Interior, accompanied by Ronald Munson | 6 |

APPENDIX

| | |
|---|---|
| Responses to additional questions | 47 |

# STATE MINING AND MINERAL RESOURCES RESEARCH INSTITUTE PROGRAM

MONDAY JUNE 27, 1988

U.S. SENATE,
SUBCOMMITTEE ON MINERAL RESOURCES
DEVELOPMENT AND PRODUCTION,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
*Washington, DC.*

The subcommittee met, pursuant to notice, at 10:25 a.m., in room, 50–360, Dirksen Senate Office Building, Hon. John Melcher, presiding.

## OPENING STATEMENT OF HON. JOHN MELCHER, U.S. SENATOR FROM MONTANA

Senator MELCHER. The subcommittee will come to order. Today we are meeting in public hearing on S. 2240. This bill reauthorizes the State Mining and Mineral Resources Research Institute Program.

The current authorization for this program is due to expire at the end of the fiscal year, September 30th. The purpose of the Institute Program is to stimulate research and training of engineers and scientists and mining and mineral resources and technology.

There was a portion, rather small portion of the strip mine bill that was passed in 1977 that set up this program. And there are 32 Institutes under the program. We're of the opinion that this program is yielding practical results and is making a significant contribution to mining and mineral development in this country.

Since 1977, the program had to be renewed once, and now we are coming into the tail end of the second reauthorization. According to the 1988 national research plan, which is required under law, between 1983 and 1987, more than 4,900 graduate degrees and 31 minerals related disciplines were awarded, and there were over 2,600 scientific publications issued.

This program has something to do with that. It does not pay for all of that, but it helps these Institutes these 32 Institutes, to fund their entire program. The money is part Federal, and of course in almost every instance part state in that most of these institutes are state universities or colleges.

And then for the private sector there was $31 million for the 32 Institutes. That was in 1988, this current year, this school year just ended, college year just ended.

The bill we are holding the hearing on today continues pretty much the same format as has been the case over the past several

years, and continues the requirement that in order for an Institute to participate in the program institutional and industrial commitment must be demonstrated. That means money.

This provides for a responsible Federal funding of a program that makes an important contribution to mineral science and technology. I look forward to hearing more about this program from our witnesses today.

We have just two witnesses, and the first is John D. Morgan, Chief Staff Officer of the Bureau of Mines, Department of the Interior.

[The text of S. 2240 follows:]

II

100TH CONGRESS
2D SESSION

# S. 2240

To amend the Act to reauthorize the State Mining and Mineral Resources Research Institute Program, and for other purposes.

---

IN THE SENATE OF THE UNITED STATES

MARCH 31, 1988

Mr. JOHNSTON introduced the following bill; which was read twice and referred to the Committee on Energy and Natural Resources

---

# A BILL

To amend the Act to reauthorize the State Mining and Mineral Resources Research Institute Program, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That any reference in this Act to the "Act of August 29, 1984", is a reference to the Act of August 29, 1984, entitled "An Act to establish a State Mining and Mineral Resources Research Institute Program, and for other purposes" (30 U.S.C. 1221–1230; 98 Stat. 1536–1542).

SEC. 2. (a) Section 1(a)(1) of the Act of August 29, 1984 (30 U.S.C. 1221(a)(1)), is amended by striking "$300,000 for the fiscal year ending September 30, 1985,

and" and inserting after "$400,000" the following: "for the fiscal year ending September 30, 1990, and".

(b) Section 1(a)(2)(A) of the Act of August 29, 1984 (30 U.S.C. 1221(a)(2)(A)), is amended to read as follows:

"(2)(A) Funds appropriated under this section shall be made available for grants to be matched on a basis of no less than two non-Federal dollars for each Federal dollar.".

(c) The second sentence of section 1(b) of the Act of August 29, 1984 (30 U.S.C. 1221(b)), is amended by deleting the phrase "production of mineral resources;" and inserting in lieu thereof "production of fuel and nonfuel mineral resources;".

SEC. 3. The first sentence of section 2(a) of the Act of August 29, 1984 (30 U.S.C. 1222(a)), is amended to read as follows: "There is authorized to be appropriated to the Secretary $15,000,000 for the fiscal year ending September 30, 1990, and for each fiscal year thereafter for four additional years, which shall remain available until expended.".

SEC. 4. Section 6(d) of the Act of August 29, 1984 (30 U.S.C. 1226(d)), is amended by striking "after September 30, 1984,".

SEC. 5. (a) Section 9(a)(7) of the Act of August 29, 1984 (30 U.S.C. 1229(a)(7)), is amended to read as follows:

"(7) seven other persons who are knowledgeable in the fields of mining and mineral resources research,

including two university administrators involved in the conduct of programs authorized by this Act, three representatives from the mining industry, a working miner, and a representative from the conservation community. In making these seven appointments, the Secretary shall consult with interested groups.".

(b) Section 9(e) of the Act of August 29, 1984 (30 U.S.C. 1229(e)), is amended by deleting the second sentence and inserting in lieu thereof the following: "The Committee shall submit such plan to the Secretary, the President, and the Congress on or before March 1, 1986, and shall submit an annual update of such plan by January 15 of each calendar year.".

SEC. 6. Section 10(b) of the Act of August 29, 1984 (30 U.S.C. 1230(b)), is amended to read as follows:

"(b) Notwithstanding the provisions of subsection (a), those colleges or universities which, on the date of enactment of this Act, have a mining or mineral resources research institute program which has been found to be eligible pursuant to this Act shall continue to be eligible pursuant to this Act subject to review at least once during the period authorized by this Act, under the provisions of section 10(a) of this Act.".

**STATEMENT OF DR. JOHN D. MORGAN, CHIEF STAFF OFFICER, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR, ACCOMPANIED BY DR. RONALD MUNSON, CHIEF, OFFICE OF MINERAL INSTITUTES, BUREAU OF MINES**

Dr. MORGAN. Good morning, Mr. Chairman. It is a pleasure to appear before your Committee to discuss the bill that is before you. I am the Chief Staff Officer of the Bureau of Mines, and I am accompanied by Dr. Ronald Munson, who is the Chief of our Office of Mineral Institutes.

I gather, sir, that you wish just an abstract of the statement, so I will make an oral statement rather than read the entire statement. I would like to point out that our statement is virtually identical with the statement that was given to the House on March 22 because the House bill and the Senate bill are substantially the same, and the position of the Administration which I am here to give is the same on both of them.

The Bureau of Mines has been very favorably disposed to government/industry/university research ever since the Bureau was founded in 1910.

In fact, our very first research station was in Pittsburgh, Pennsylvania, right next door to Carnegie Tech University, which at that time was a noted Institution for mining engineering and metallurgy.

Pittsburgh at that time was the center of the coal industry, the steel industry, the aluminum industry, much of the petroleum industry, and the chemical industry. Therefore, this facilitated government/industry/university cooperation more than 70 years ago.

Subsequently, as the Bureau expanded, our policy almost invariably was to locate Bureau of Mines research stations on the campuses of major universities so that today we have some 13 field stations, most of which are on university campuses or very close to them.

The idea of this is to facilitate government/industry/university working together to allow graduate students and professors at the universities to use Bureau facilities and to permit Bureau people to take advantage of university educations. It has been mutually beneficial, we believe, all of this time.

With respect to the specific item of legislation that is before you; namely, S. 2240, the Administration cannot support the bill as presently drafted. We would not oppose specific reauthorization of the Centers of Generic Mineral Technology and reauthorization of the work of the Advisory Committee.

We believe that the centers are particularly important in focusing government/industry/university research in areas that are very broad and cover major sections of the entire mineral industry.

The Advisory Committee brings together people from the private sector, from the National Academy of Sciences, the National Academy of Engineering, the National Science Foundation, the U.S. Geological Survey, the Bureau of Mines, and university people, as well as industry people, to guide these programs.

We are always cognizant of the need to have arrangements in case of some national defense emergency where under the Defense Production Act the Interior Department is responsible for emergency planning for minerals.

If we did have such an emergency, the Advisory Committee would be a very useful group to bring further scientific and engineering attention to solving such emergency problems.

So our position is that we would agree with the reauthorization of the Generic Centers and the Advisory Committee. But I am constrained to point out that in this period of budgetary deficits, increasing deficits, our endorsement of this limited direction does not necessarily imply that we would request future funding for this program.

Sir, that completes the summary of the statement, and we are prepared to answer any questions.

Statement of Dr. John D. Morgan
Chief Staff Officer, Bureau of Mines
Department of the Interior
before the
Subcommittee on Mineral Resources Production and Development
Committee on Energy and Natural Resources
United States Senate
June 27, 1988

Mr. Chairman and Members of the Committee, we appreciate the opportunity to appear before you to present the Department of the Interior's views on S. 2240, a bill to extend the State Mining and Mineral Resources Research Institute program. I am accompanied by Dr. Ronald A. Munson, Chief, Office of Mineral Institutes of the Bureau of Mines. My involvement with this program goes back more than 20 years, because I served from 1965 to 1969 as a member of the Committee on Mineral Science and Technology of the National Academy of Sciences which recommended increased Government/industry/university cooperation in mineral-related research and I have represented the Bureau of Mines on the Advisory Committee since the Mineral Institute program was established by law in 1977. Dr. Munson, with long experience as a Bureau of Mines scientist, has been Chief of the Office of Mineral Institutes since 1982, when the program was transferred by the Secretary of the Interior to the Bureau of Mines.

The Mineral Institute Program was initiated to provide seed money to encourage the development of mineral-related Government/industry/university research and graduate education programs at selected State colleges and universities. The States have responded and the programs are in place. The majority of the support at these schools comes from non-Federal sources. Accordingly, this program is no longer an appropriate use of Federal funds, as State and private resources are adequate to continue the program at an appropriate level.

In view of the continuing Federal budgetary deficits, the Administration cannot support S. 2240 as presently drafted. However, we would not oppose specific reauthorization of the centers of generic mineral technology and a continuation of the Advisory Committee. The current generic mineral technology areas provide broad-based research facilities and personnel that complement and supplement basic research critical to the Nation's economy and security. The legally authorized Advisory Committee now provides a useful focal point for review and recommendations on mining and mineral resources research, and, in the event of a national emergency, it could aid in mobilizing scientific resources in this important area. The allotment grant program is now sufficiently mature as to be sustained by the States and the private sector.

However, as we indicated in the President's Budget, the Administration does not believe that Federal funding is needed to continue this program. Our not objecting to a narrow programmatic reauthorization should not be construed as a commitment to necessarily request future funding.

Ever since its establishment in 1910, the Bureau of Mines has been fully cognizant of the need for Government/industry/university involvement in research to improve health and safety and efficiency in the mineral industries. The Bureau's first research station was established in Pittsburgh, Pennsylvania, next door to Carnegie Tech University, a prominent center of excellence in mining engineering and metallurgy. I might add that we are working with Carnegie Mellon University presently on robotic devices that offer promise of moving miners back from the dangers of the mine face. In 1910, Pittsburgh was a major center of the U.S. steel, coal, oil, gas, aluminum, and other mineral industries, facilitating Government/industry/ university cooperation.

In its many years of existence the Bureau has actively maintained a synergistic relationship among Government/industry/university researchers to foster and encourage innovation and technology transfer. The proximity of Bureau research centers to major universities permits university professors and graduate students to utilize specialized Bureau facilities, while also allowing Bureau scientists to serve as adjunct professors in their areas of specialization. Technology transfer occurs not only through directed Bureau activities but also through numerous meetings at local, State, and national levels of the many professional societies concerned with various sectors of the mineral industry. We encourage our Bureau researchers to participate in these fruitful exchanges.

Sections 3 and 5 of the Organic Act of the Bureau of Mines (Exhibit "A") provide broad authority for the Bureau to do whatever is necessary with regard to research, either in-house or in cooperation with others. Our 13 field locations listed in Exhibit "A" provide convenient access by the mineral industry. Moreover, each of our research centers is located either on the campus of a well-known mineral-oriented university or in close proximity thereto.

To more sharply focus some of the research, in 1982 the Advisory Committee took the lead in establishing Centers of Generic Mineral Technology, each to cover a major research area of the mineral industry that would be applicable to many diverse interests. As illustrated in Exhibit "B," established Centers already functioning include: Mine Systems Design and Ground Control, Comminution (a technical term for crushing and grinding), Pyrometallurgy, Mineral Industry Waste Treatment and Recovery, and Respirable Dust. Projects underway at these five Generic Centers are listed in the December 15, 1987 "Report on the Mineral Institute Program," (part of Exhibit "C").

The 1984 Act which reauthorized the Mineral Institute program (PL 98-409) directed the Committee on Mining and Mineral Resources Research to develop a national plan for research in mining and mineral resources. This plan, entitled "Improving Research and Education in Mineral Science and Technology Through Government - (Federal, State, and Local), Industry and University Cooperation" was submitted to the President and the Congress in 1986. The Act also mandates an annual updating of the plan. The second update prepared by the Advisory Committee was dated December 15, 1987, and was submitted to

the President and the Congress by Secretary Hodel on March 4, 1988 (Exhibit "C"). In essence, the original plan and the subsequent updates endorse ongoing research by regular Government agencies, particularly the National Science Foundation and the Departments of the Interior, Energy, Defense, and Commerce, and the plan noted that university participation should be on a competitive basis to ensure diversity, quality, and productivity, with Generic Mineral Technology Centers having highest priority.

Since its inception in 1977 through fiscal year 1988, over $97 million has been made available to the program. Some $85 million has been obligated for the Mineral Institute program as detailed in Exhibit "D". Approximately another $12.5 million is available in this year, fiscal year 1988, and we are now establishing two additional Generic Centers: a Marine Minerals Technology Center, based on the University of Mississippi and the University of Hawaii at Manoa, and a National Mine Land Reclamation Center, based on the University of West Virginia. These latter two Generic Centers were mandated by the Congress in the legislation providing for Bureau operations in fiscal year 1988. To implement the "Center for Cataloging" concept, each of the Generic Centers maintains a "Reference Center" with in-depth coverage of relevant scientific and technical publications, as well as information on research projects underway.

Mr. Chairman, that concludes my prepared statement and we shall be pleased to reply to any questions.

Title 30, USCA

## § 3. Same; duties of Bureau of Mines

It shall be the province and duty of the Bureau of Mines, subject to the approval of the Secretary of the Interior, to conduct inquiries and scientific and technologic investigations concerning mining, and the preparation, treatment, and utilization of mineral substances with a view to improving health conditions, and increasing safety, efficiency, economic development, and conserving resources through the prevention of waste in the mining, quarrying, metallurgical, and other mineral industries; to inquire into the economic conditions affecting these industries; to investigate explosives and pest; and on behalf of the Government to investigate the mineral fuels and unfinished mineral products belonging to, or for the use of, the United States, with a view to their most efficient mining, preparation, treatment, and use; and to disseminate information concerning these subjects in such manner as will best carry out the purposes of the provisions of sections 1, 3, and 5 to 7 of this title.

May 16, 1910, c. 240, § 2, 36 Stat. 370; Feb. 25, 1913, c. 72, 37 Stat. 681; Ex.Ord.No.4239, June 4, 1925; Ex.Ord.No.6611, Feb. 22, 1934.

## § 5. Reports of investigations

The Director of the Bureau of Mines shall prepare and publish, subject to the direction of the Secretary of the Interior, under the appropriations made from time to time by Congress, reports of inquiries and investigations, with appropriate recommendations of the bureau, concerning the nature, causes, and prevention of accidents, and the improvement of conditions, methods, and equipment, with special reference to health, safety, and prevention of waste in the mining, quarrying, metallurgical, and other mineral industries; the use of explosives and electricity, safety methods and appliances, and rescue and first-aid work in said industries; the causes and prevention of mine fires; and other subjects included under the provisions of sections 1, 3, and 5 to 7 of this title.

May 16, 1910, c. 240, § 3, 36 Stat. 370; Feb. 25, 1913, c. 72, 37 Stat. 681; Ex.Ord.No.4239, June 4, 1925; Ex.Ord.No.6611, Feb. 22, 1934.

**Field Officials**

*Alaska Field Operations Center* AFOC
*901 E. 9th Avenue, Suite 101*
*Anchorage, AK 99501*
*(907) 261-2655*
*Chief:* Donald P. Blasko

*Albany Research Center* ALRC
*1450 Queen Avenue, S.W.*
*P.O. Box 70*
*Albany, OR 97321*
*(503) 967-5883*
*Research Director:* George J. Dooley III

*Denver Research Center* DRC
*Building 20, Denver Federal Center*
*Denver, CO 80225*
*(303) 236-0697*
*Research Director:* Edward E. Holley

*Helium Field Operations* HFO
*100 South Fillmore Street*
*Amarillo, TX 79101*
*(806) 376-2600*
*General Manager:* L. Dale Biggus

*Reno Research Center* RERC
*1605 Evans Avenue*
*Reno, NV 89520*
*(702) 784-5391*
*Research Director:* Arthur F. Colombo

*Rolla Research Center* RORC
*1300 Bishop Avenue*
*P.O. Box 280*
*Rolla, MO 65401*
*(314) 364-3189*
*Research Director:* Donald L. Paulson

*Salt Lake City Research Center* SLCRC
*729 Arapeen Drive*
*Salt Lake City, UT 84108*
*(801) 524-6100*
*Research Director:* Stephen D. Hill

*Spokane Research Center* SRC
*E. 315 Montgomery Avenue*
*Spokane, WA 99207*
*(509) 484-1610*
*Research Director:* Douglas D. Boleszad

*Tuscaloosa Research Center* TURC
*P.O. Box L*
*University, AL 35486*
*(205) 758-0491*
*Research Director:* Martin H. Stanczyk

*Intermountain Field Operations Center* IFOC
*Building 20, Denver Federal Center*
*Denver, CO 80225*
*(303) 236-0421*
*Chief:* William T. Cochran

*Pittsburgh Research Center* PRC
*Cochrans Mill Road*
*P.O. Box 18070*
*Pittsburgh, PA 15236*
*(412) 892-6601*
*Research Director:* John N. Murphy

*Twin Cities Research Center* TCRC
*5629 Minnehaha Avenue South*
*Minneapolis, MN 55417*
*(612) 725-4610*
*Research Director:* Lewis V. Wade

*Western Field Operations Center* WFOC
*E. 360 Third Avenue*
*Spokane, WA 99202*
*(509) 456-5350*
*Chief:* Richard B. Grabowski

Exhibit "A"

THE RELATIONSHIP OF THE GENERIC MINERAL TECHNOLOGY CENTERS
TO STEPS IN THE PROCESSING OF MINERAL MATERIALS

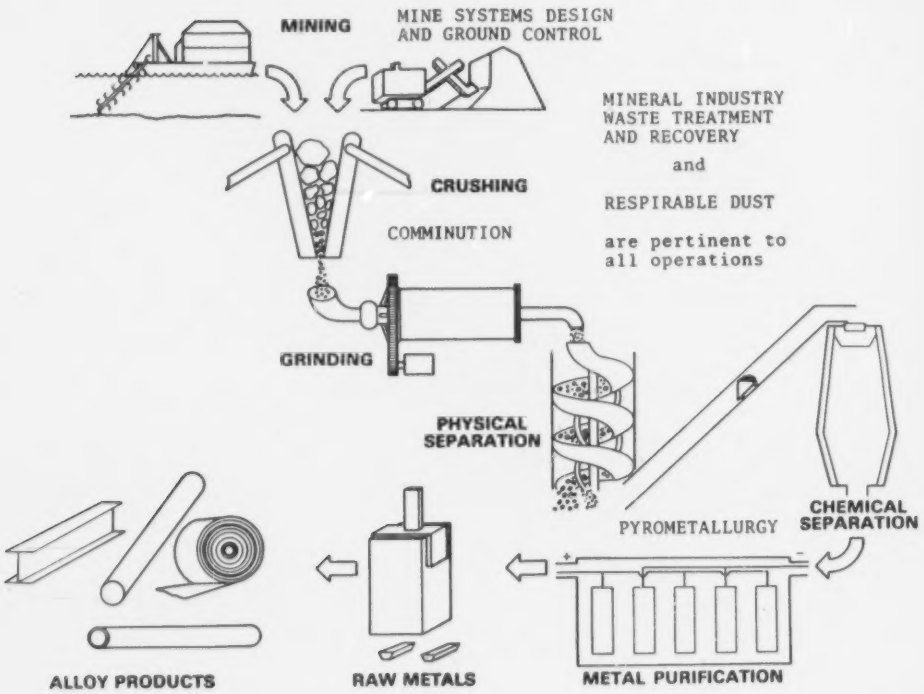



Exhibit "B"

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

March 4, 1988

The President
The White House
Washington, D.C. 20500

Dear Mr. President:

Enclosed please find the "1988 Update to the National Plan for Research in Mining and Minerals Resources" and "The 1987 Report on the Mineral Institute Program of the U.S. Department of the Interior" pursuant to Secs. 4. (c) and 9. (e), Public Law 98-409, State Mining and Mineral Resources Research Institute Program Act of 1984.

Sincerely,

/s/

DONALD PAUL HODEL

Enclosures

Identical letters to:
Honorable George Bush, President of the Senate
Honorable Jim C. Wright, Jr., Speaker of the House of Representatives

Exhibit "C"

90-486 0 - 88 - 2

December 15, 1987

# 1988 UPDATE TO THE NATIONAL PLAN FOR RESEARCH IN MINING AND MINERAL RESOURCES

Report to:

The Secretary of the Interior
The President of the United States
The President of the Senate
The Speaker of the House of Representatives

Section 9(e) of Public Law 98-409 of August 29, 1984, (98 Stat. 1536 et seq.) mandates that the Committee on Mining and Mineral Resources Research submit an annual update to the National Plan for Research in Mining and Mineral Resources: "Improving Research and Education in Mineral Science and Technology through Government-(Federal, State and Local), Industry, and University Cooperation."

The rocks, soils, and fluids of the earth are the source of the minerals required for national security and economic development. Coal, petroleum, natural gas, and uranium supply almost all of our energy, and petrochemicals are the feedstocks for plastics. Nitrogen, phosphorus, potassium, and sulfur are major fertilizer components, which, with more than two dozen trace elements, make possible our abundant agriculture. Stone, sand, gravel, and cement are widely used construction materials. Iron, copper, lead, zinc, nickel, and chromium have extensive uses in machinery and consumer products. And now rare elements, such as gallium, germanium, indium, neodymium, rhenium, scandium, and yttrium, make possible numerous high-technology applications.

Searching for mineral resources and improving use antedate the foundation of the nation. Since then, federal and state legislation, too varied and numerous to document, has been enacted to encourage resource development. Recent major items of legislation specifically referring to minerals include: the Defense Production Act, the Stock Piling Act, the Mining and Minerals Policy Act, the National Materials and Minerals Policy, Research and Development Act, the National Critical Materials Act, and our Act cited in paragraph 1 above.

The present period is characterized by increasing world competitiveness, a broad spectrum of threats to the independence of free peoples, heightened environmental concerns, and increasing indebtedness. Consequently, recognizing the need to make maximum effective use of the nation's scientific and engineering resources, the President, on April 10, 1987, issued Executive Order 12591 (Appendix "A") entitled "Facilitating Access to Science and Technology." Section 6 of EO 12591 clearly endorses the recommendation of our first two reports that

GOVERNMENT/INDUSTRY/UNIVERSITY COOPERATION IN RESEARCH IS THE MOST EFFECTIVE WAY TO MARSHAL OUR CRITICAL SKILLS AND SPECIALIZED FACILITIES.

In the early years of this decade, this Committee took the lead in 2/3
establishing five "Generic Mineral Technology Centers," each intended to bring together government, industry, and universities across state lines to form "Centers" with critical masses for effective research applicable to some major elements of the mineral sector of the economy. These Centers are:

Mine Systems Design and Ground Control (centered at Virginia Polytechnic Institute and State U., with affiliates at U. of Alabama, U. of Alaska-Fairbanks, Colorado School of Mines, U. of Idaho, Southern Illinois U., U. of Kentucky, and U. of Nevada-Reno): brings together experts familiar with conditions ranging from the permafrost of the Arctic to the Tropics, and also with fuels, nonmetallics, metals, brines, and open-pit and underground mines.

Comminution (centered at U. of Utah, with affiliates at U. of Minnesota, U. of California-Berkeley, Colorado School of Mines, Michigan Technological U., New Mexico Institute of Mining and Technology, Pennsylvania State U., and Virginia Polytechnic Institute and State U.): devoted to crushing and grinding because, with the exception of sand, gravel, and ornamental cut stone, almost all minerals after mining are reduced in size to facilitate removal of unwanted constituents and to improve recovery of desired elements or compounds. Moreover, comminution is an energy-intensive process and improvements should also improve the efficiency of energy utilization.

Pyrometallurgy (centered at U. of Missouri-Rolla, with affiliates at Purdue U., Ohio State U., Massachusetts Institute of Technology, and U. of Utah): applications of high temperatures to mineral processes such as smelting, refining, and alloying in major industries including steel, copper, lead, zinc, nickel, ferroalloys, and refractory metals.

Mineral Industry Waste Treatment and Recovery (centered at U. of Nevada-Reno, with affiliates at U. of Idaho., Montana College of Mineral Science and Technology, New Mexico Institute of Mining and Technology, Pennsylvania State U., and South Dakota School of Mines and Technology): focussing on controlling the fumes, dusts, and liquid and solid wastes generated throughout the mineral sector of the economy, many of which, if properly treated, are sources of valuable materials.

Respirable Dust (centered at Pennsylvania State U. and West Virginia U., with affiliates at U. of Minnesota and Massachusetts Institute of Technology): brings together experts concerned with particles causing potentially disabling or fatal diseases, including pneumoconiosis ("black-lung"), silicosis, and asbestosis, the latter of deep concern not just to workers in the mineral sector of the economy but also to the general populace.

The "1987 Report on the Mineral Institute Program of the U.S. Department of the Interior" (Appendix "B") includes a list of the research projects currently under way at the five Generic Mineral Technology Centers.

The National Science Foundation (NSF) establishes "Engineering Centers" in other areas, some of which, such as those involving Advanced Combustion, Composities, Net Shape Manufacturing, and Hazardous Substance Control, relate to the mineral sector of the economy. Moreover, NSF's active support of basic research in the physical and life sciences and engineering contributes importantly to the fundamental scientific base which is drawn upon by the more applied disciplines in our area such as geology, geophysics, geochemistry, geobotany, mining engineering, geological engineering, petroleum and natural gas engineering, metallurgy, and ceramics. The Department of Energy supports a broad spectrum of research involving mineral fuels and fuel technology. The Committee also notes the importance of the continued research efforts of the U.S. Geological Survey, which for more than a century has enjoyed a worldwide reputation, and of the Bureau of Mines, which similarly has been in the forefront of world mineral research for eight decades. Researchers at the Mineral Institutes are cognizant of related work and the program is managed to avoid undesired duplication.

A specific responsibility of the Committee, set forth in Section 10 of the Act, is to determine the eligibility of institutions participating as mining and mineral resources research institutes. During 1987 the Committee conducted a detailed review of the 32 Mineral Institutes, utilizing the criteria specified in the Act. The Committee is now evaluating the eligibility of those institutions on the basis of that review. Whether additional Generic Mineral Technology Centers may be needed is also a question that needs to be considered, especially in the light of the fact that, in considering Fiscal Year 1988 budgets, the Congress has moved to create additional mineral-related centers. Consequently, to avoid wasteful duplication of effort, to assure appropriate integration with existing programs, and to provide necessary oversight, legislation establishing such new mineral-related centers should provide that they come under the purview and jurisdiction of Public Law 98-409, thus assuring consistency with the national plan for research in mining and mineral resources.

In the past decade the Mineral Institute program has made major improvements in university research in mineral science and technology, and the Committee feels that continued encouragement by industry and government is in the national interest.

SIGNED:

Carl L. Randolph
Mining Industry

Win Aung
National Science Foundation

Don L. Warner
University Administrator

Walter R. Hibbard, Jr.
National Academy of Sciences

John H. DeYoung, Jr.
U.S. Geological Survey

Joseph N. Crowley
University Administrator

John C. Calhoun, Jr.
National Academy of Engineering

John D. Morgan
Bureau of Mines

Edward S. Fromling
Mining Industry

Orme Lewis, Jr.
Conservation Community
COCHAIR

James W. Ziglar
Asst. Secretary-Water & Science
U.S. Department of the Interior
COCHAIR

(Brief biographies are in Appendix "C")

Executive Order 12591 of April 10, 1987

Appendix "A"

## Facilitating Access to Science and Technology

By the authority vested in me as President by the Constitution and laws of the United States of America, including the Federal Technology Transfer Act of 1986 (Public Law 99-502), the Trademark Clarification Act of 1984 (Public Law 98-620), and the University and Small Business Patent Procedure Act of 1980 (Public Law 96-517), and in order to ensure that Federal agencies and laboratories assist universities and the private sector in broadening our technology base by moving new knowledge from the research laboratory into the development of new products and processes, it is hereby ordered as follows:

**Section 1.** *Transfer of Federally Funded Technology.*

(a) The head of each Executive department and agency, to the extent permitted by law, shall encourage and facilitate collaboration among Federal laboratories, State and local governments, universities, and the private sector, particularly small business, in order to assist in the transfer of technology to the marketplace.

(b) The head of each Executive department and agency shall, within overall funding allocations and to the extent permitted by law:

(1) delegate authority to its government-owned, government-operated Federal laboratories:

(A) to enter into cooperative research and development agreements with other Federal laboratories, State and local governments, universities, and the private sector; and

(B) to license, assign, or waive rights to intellectual property developed by the laboratory either under such cooperative research or development agreements and from within individual laboratories.

(2) identify and encourage persons to act as conduits between and among Federal laboratories, universities, and the private sector for the transfer of technology developed from federally funded research and development efforts;

(3) ensure that State and local governments, universities, and the private sector are provided with information on the technology, expertise, and facilities available in Federal laboratories;

(4) promote the commercialization, in accord with my Memorandum to the Heads of Executive Departments and Agencies of February 18, 1983, of patentable results of federally funded research by granting to all contractors, regardless of size, the title to patents made in whole or in part with Federal funds, in exchange for royalty-free use by or on behalf of the government;

(5) implement, as expeditiously as practicable, royalty-sharing programs with inventors who were employees of the agency at the time their inventions were made, and cash award programs; and

(6) cooperate, under policy guidance provided by the Office of Federal Procurement Policy, with the heads of other affected departments and agencies in the development of a uniform policy permitting Federal contractors to retain rights to software, engineering drawings, and other technical data generated by Federal grants and contracts, in exchange for royalty-free use by or on behalf of the government.

**Sec. 2.** *Establishment of the Technology Share Program.* The Secretaries of Agriculture, Commerce, Energy, and Health and Human Services and the Administrator of the National Aeronautics and Space Administration shall select one or more of their Federal laboratories to participate in the Technology Share Program. Consistent with its mission and policies and within its overall funding allocation in any year, each Federal laboratory so selected shall:

(a) Identify areas of research and technology of potential importance to long-term national economic competitiveness and in which the laboratory possesses special competence and/or unique facilities;

(b) Establish a mechanism through which the laboratory performs research in areas identified in Section 2(a) as a participant of a consortium composed of United States industries and universities. All consortia so established shall have, at a minimum, three individual companies that conduct the majority of their business in the United States; and

(c) Limit its participation in any consortium so established to the use of laboratory personnel and facilities. However, each laboratory may also provide financial support generally not to exceed 25 percent of the total budget for the activities of the consortium. Such financial support by any laboratory in all such consortia shall be limited to a maximum of $5 million per annum.

**Sec. 3.** *Technology Exchange—Scientists and Engineers.* The Executive Director of the President's Commission on Executive Exchange shall assist Federal agencies, where appropriate, by developing and implementing an exchange program whereby scientists and engineers in the private sector may take temporary assignments in Federal laboratories, and scientists and engineers in Federal laboratories may take temporary assignments in the private sector.

**Sec. 4.** *International Science and Technology.* In order to ensure that the United States benefits from and fully exploits scientific research and technology developed abroad,

(a) The head of each Executive department and agency, when negotiating or entering into cooperative research and development agreements and licensing arrangements with foreign persons or industrial organizations (where these entities are directly or indirectly controlled by a foreign company or government), shall, in consultation with the United States Trade Representative, give appropriate consideration:

(1) to whether such foreign companies or governments permit and encourage United States agencies, organizations, or persons to enter into cooperative research and development agreements and licensing arrangements on a comparable basis;

(2) to whether those foreign governments have policies to protect the United States intellectual property rights; and

(3) where cooperative research will involve data, technologies, or products subject to national security export controls under the laws of the United States, to whether those foreign governments have adopted adequate measures to prevent the transfer of strategic technology to destinations prohibited under such national security export controls, either through participation in the Coordinating Committee for Multilateral Export Controls (COCOM) or through other international agreements to which the United States and such foreign governments are signatories.

(b) The Secretary of State shall develop a recruitment policy that encourages scientists and engineers from other Federal agencies, academic institutions, and industry to apply for assignments in embassies of the United States; and

(c) The Secretaries of State and Commerce and the Director of the National Science Foundation shall develop a central mechanism for the prompt and efficient dissemination of science and technology information developed abroad to users in Federal laboratories, academic institutions, and the private sector on a fee-for-service basis.

**Sec. 5.** *Technology Transfer from the Department of Defense.* Within 6 months of the date of this Order, the Secretary of Defense shall identify a list of funded technologies that would be potentially useful to United States industries and universities. The Secretary shall then accelerate efforts to make these technologies more readily available to United States industries and universities.

**Sec. 6.** *Basic Science and Technology Centers.* The head of each Executive department and agency shall examine the potential for including the establishment of university research centers in engineering, science, or technology in the strategy and planning for any future research and development programs. Such university centers shall be jointly funded by the Federal Government, the private sector, and, where appropriate, the States and shall focus on areas of fundamental research and technology that are both scientifically promising and have the potential to contribute to the Nation's long-term economic competitiveness.

**Sec. 7.** *Reporting Requirements.* (a) Within 1 year from the date of this Order, the Director of the Office of Science and Technology Policy shall convene an interagency task force comprised of the heads of representative agencies and the directors of representative Federal laboratories, or their designees, in order to identify and disseminate creative approaches to technology transfer from Federal laboratories. The task force will report to the President on the progress of and problems with technology transfer from Federal laboratories.

(b) Specifically, the report shall include:

(1) a listing of current technology transfer programs and an assessment of the effectiveness of these programs;

(2) identification of new or creative approaches to technology transfer that might serve as model programs for Federal laboratories;

(3) criteria to assess the effectiveness and impact on the Nation's economy of planned or future technology transfer efforts; and

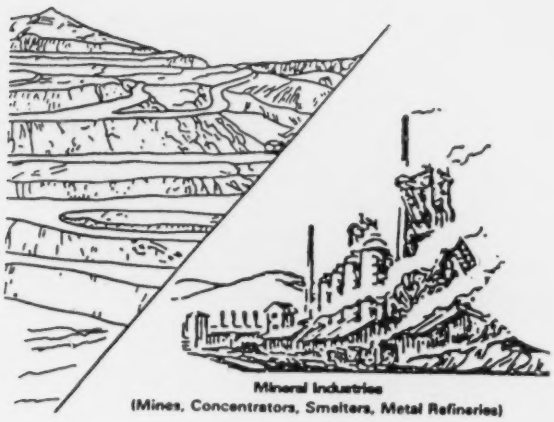
(4) a compilation and assessment of the Technology Share Program established in Section 2 and, where appropriate, related cooperative research and development venture programs.

**Sec. 8.** *Relation to Existing Law.* Nothing in this Order shall affect the continued applicability of any existing laws or regulations relating to the transfer of United States technology to other nations. The head of any Executive department or agency may exclude from consideration, under this Order, any technology that would be, if transferred, detrimental to the interests of national security.

Ronald Reagan

THE WHITE HOUSE,
*April 10, 1987.*

Appendix "B"




The 1987 Report on the Mineral Institute Program of the

U.S. Department of the Interior

Government/Industry/University

Research Cooperation

Pursuant to PL 98-409

December 15, 1987

Mineral Institute Program 1987 Annual Report

ACTIVITY OVERVIEW

In order to encourage State support for basic research in the mineral sciences and engineering, allotment grants, which must be matched, are made to designated State Mineral Institutes (no more than one per State) at research-oriented schools of higher learning. The Mineral Institute program is authorized under Public Law 98-409 through fiscal year 1989. This Act requires allotment grant matching on the basis of 2 State dollars for each Federal dollar in fiscal years 1987, 1988, and 1989. The designation of a State institution of higher learning as a Mineral Institute creates an administrative mechanism for channeling funds to academic departments in response to their contribution to mineral engineering research. In addition to allotment grants, research grants are made in five generic mineral technology areas to the designated Institutes in support of research of broad applicability to the minerals industry. Concentration of research funds to develop focal points for research in particular mineral-related areas was done in response to a 1982 congressional directive to consolidate the Mineral Institute program. The 32 institutions eligible to participate in the program in 1988 are:

1. University of Alabama
2. University of Alaska - Fairbanks
3. University of Arizona
4. University of California - Berkeley
5. Colorado School of Mines
6. Georgia Institute of Technology
7. University of Idaho
8. Southern Illinois University
9. Purdue University (Indiana)
10. Iowa State University
11. University of Kentucky
12. Louisiana State University
13. Massachusetts Institute of Technology
14. Michigan Technological University
15. University of Minnesota
16. University of Mississippi
17. University of Missouri - Rolla
18. Montana College of Mineral Science and Technology
19. University of Nevada - Reno
20. New Mexico Institute of Mining and Technology
21. Columbia University (New York)
22. University of North Dakota
23. Ohio State University
24. University of Oklahoma

25. Pennsylvania State University
26. South Dakota School of Mines and Technology
27. University of Texas
28. University of Utah
29. Virginia Polytechnic Institute and State University
30. University of Washington
31. West Virginia University
32. University of Wyoming.

ALLOTMENT GRANT PROGRAM

Effective each July 1, new allotment grants are made to each of the Mineral Institutes. These awards of $138,000 for support during the 1987-88 school year, were made on the basis of proposals received from each Institute and approved by the Bureau of Mines. No allotment was withheld.

In 1987, allotment funds were used for student support as 132 undergraduate and 314 graduate students were aided in obtaining degrees in mineral-related fields. A major portion of the Mineral Institute allotment funds was used to support 238 research miniprojects. Although no mineral conferences were sponsored this year, 24 continuing education courses were offered. Three special mineral courses and a student field trip also received aid. Equipment purchases were more widespread. Twenty-two major scientific instruments were purchased for 12 laboratories and 6 institutions added to their stock of computers and peripherals. At three institutions, funds were used on maintenance contracts for major equipment. In addition, three institutions used funds to support technicians and one visiting professor and 10 post-doctoral students were supported. Books were purchased for the libraries at 8 schools. Two institutions used funds to aid in the preparation and distribution of newsletters and one institution continued to support the preparation of a State Mineral Producers List and Handbook.

While the Mineral Institute program does not support construction of facilities, its presence encourages States to erect appropriate facilities. At the University of Missouri-Rolla, the $14 million V. H. McNutt Mineral Engineering building, housing six academic departments of the Missouri School of Mines, was completed this year. A new 118,000 square foot Minerals and Materials Building is under construction at Michigan Technological University. The building which will cost $27 million, will house mining engineering, metallurgical engineering, and the Institute for Materials Processing. The State of Michigan will provide an additional $10 million to equip the building now scheduled for completion in October 1989. At Purdue University, 49,000 square feet of a new wing of the Civil Engineering Building, now under construction, will be occupied next year by the Department of Geosciences and an additional 16,000 square feet by Geotechnical Engineering. Also at Purdue, materials engineering will move into part of a new engineering building in the spring of 1988. This year, Montana College of Mineral Science and Technology completed a new 50,000 square foot building at a cost of $5.7 million for the Departments of

3

Metallurgy, Mineral Processing, and Geophysical Engineering. The former Bureau of Mines facilities on the University of Utah campus that have been renovated and earthquake proofed, are now being used by the School of Engineering and the College of Mines. Immediately adjacent 50 percent of a new 50,000 square foot Energy and Minerals Research Laboratory built at a cost of $4.3 million is being used by the College of Mines. And adjacent to that building, a largely underground Energy and Minerals Classroom building having 60,000 square feet and costing $5.8 million was completed this year. A new 150,000 square foot Mineral Research building estimated to cost $18.5 million is being built on the campus of the University of Alabama for use in April 1989. To be added later at Alabama is a 55,000 square foot engineering and science library on campus and a pilot plant off campus for an additional $20 million. A new $7.8 million building at the University of Kentucky will soon be occupied by Mining Engineering, the Kentucky Geological Survey, coal geology research, and the Mineral Institute. Construction is carried out using funds from sources other than the Mineral Institute appropriations.

## GENERIC CENTER RESEARCH PROGRAM

Research grants are concentrated in five generic mineral technology areas of broad applicability across the minerals industry. Each generic area has at least one lead institution which coordinates research activities in that area, provides for Annual Seminars, and operates Reference Centers which disseminate research results relating to its particular area of research expertise. In 1987, additional grants totaling $5,398,610 were made in the five generic mineral technology areas.

| Generic Area | Lead Institutions | Affiliates |
|---|---|---|
| Mine Systems Design and Ground Control | Virginia Polytechnic Institute and State University | University of Alabama<br>University of Alaska-Fairbanks<br>University of Arizona<br>Colorado School of Mines<br>University of Idaho<br>Southern Illinois University<br>University of Kentucky<br>University of Nevada - Reno<br>University of Utah |
| Comminution | University of Utah | University of Minnesota<br>University of California - Berkeley<br>Colorado School of Mines<br>Michigan Technological University<br>Pennsylvania State University<br>Virginia Polytechnic Institute and State University |

| Generic Area | Lead Institutions | Affiliates |
|---|---|---|
| Mineral Industry Waste Treatment and Recovery | University of Nevada - Reno | University of Arizona<br>Colorado School of Mines<br>University of Minnesota<br>Montana College of Mineral Science and Technology<br>New Mexico Institute of Mining and Technology<br>University of Oklahoma<br>Pennsylvania State University<br>South Dakota School of Mines and Technology. |
| Pyrometallurgy | University of Missouri-Rolla | Purdue University<br>Ohio State University<br>Massachusetts Inst. of Technology<br>University of Utah<br>University of Kentucky. |
| Respirable Dust | Pennsylvania State University<br>West Virginia University | University of Minnesota<br>Massachusetts Inst. of Technology<br>Michigan Technological University. |

Research Projects Underway in FY 1988

Mine Systems Design and Ground Control

Longwall Interaction in Multi-Seam Mining
Upper Seam Stabilization in Multi-Seam Mining
Underground Characterization of Strata Using Advanced Statistical Methods
Improved Airflow and Climate of Underground Mines
Mine Management Decision Support
Post-Failure Behavior of Coal Pillars
Diesel and Electric-Cable-Reel Shuttle-Car Comparison
Alabama Coal Field Subsidence
Access Design in Permafrost
Failure in Coal-Bearing Roofs
Reinforced Timber Posts
Underground Booster Fans
Holographic Testing of Materials for Surface Mining
Design Problems of a Surface Coal Mine in North Slope of Alaska
Thick Seam Coal Mining Systems Design
Soft Floor Interaction on Room and Pillar Coal Mining

Mine Systems Design and Ground Control (continued) 5

Knowledge Systems for Electrical Maintenance of Underground Mining Machines
Immediate Floor Strata Deformability
Rock Mass Stiffness Using Surface Wave Geophysics
Analysis of Longwall Failures
Control Measures for Surface Structure Above Undermined Areas
Cable Bolting in Vertical Crater Retreat Stopes
Thick Seam Coal Mine Design

Comminution

Computer Simulation of Complex Circuits
Large Grinding Mill Dynamics
Phenomenological Model of Hydrocyclones and Wet Screening
Tracer Study of Rod Mill Transport
Application of Modern Control Theory to Crushing
Fluid-Flow and Particle Trajectories in Hydrocyclone Using Motion Analyzer
Numerical Simulation of Comminution in Jointed Geological Media
Semi-Autogenous Grinding
Evaluation of Two-Stage Classification
Density Interaction in Hydrocyclones
New Technology Evaluation
Liberation Analysis of Multicomponent Systems
Effect of Microfractures on Rock Fragmentation by Explosives
Tumbling Mill Efficiency
Improved Grinding Circuit Performance and Slurry Rheology
Mechanism of Corrosive Wear of Grinding Media
Roll Mills for Fine Comminution
Automatic Control of Two-Stage Classification
Volumetric Composition of Locked Particles by Energy Dispersive Analysis
Breakage Characteristics of Particle Mixtures

Mineral Industry Waste Treatment and Recovery

Precipitation Mechanisms of Heavy Metals
Dissolution of Lead From Smelter Dusts
Recovery of Copper and Arsenic From Electrorefining Wastes
Tailing Fluids Waste treatment
Phosphorus Removal From Steelmaking Slags
Controlling Acid Mine Drainage at the Bunker Hill Mine
Supercritical Extraction of Platinum-Group Metals
Cyanide in Mill Tailings Impoundments
Acid-Producing Hot Spots Within Reclaimed Surface Mine Spoil
Spatial Variability of Mill Tailings Hydraulic Properties
Fluoride Wastes From Mineral Processing Plants
Flotation of Fines
Clean-up of Mine Waters Using Electrodialysis
Stainless Steel Spent Pickling Solutions
Stable and Filterable Precipitates for Removal of Toxic Waste Species

Mineral Industry Waste Treatment and Recovery (continued)

- Suspended Solids Recovery Using Fluidized and Packed Beds
- Hazardous Effluent Movement in the Subsurface Using Complex Geotomography (radar image reconstruction)
- Enhanced Volatilization of Arsenic and Antimony From Flue Dusts and Speiss
- Plasma Process to Treat Electric Furnace Dust
- Hydrometallurgical Treatment of Zinc-Bearing Toxic Wastes
- Flotation of Multivalent Ion Concentrating Algae
- Cyanide Fate in the Liquid Phase of Heaps.

Pyrometallurgy

- Control of Dross Formation During Lead Refining
- Mineralogy of Pyrometallurgical Feeds and Products
- Gas-Solid Reactions: Pyrophoricity
- Fluid Dynamics of Liquid Metal Atomization
- Kinetics of Gas-Slag Reactions
- High Temperature Gas-Particle Reactions
- Behavior of Oxygen and Sulfur in Complex Mattes
- Electrochemical Factors in Fused Salt Enhanced Reduction
- Mechanisms of Attack and Protection of Refractories
- Reaction Kinetics of Reduction Bath Smelting
- Control of Mixing by Submerged Gas Injection
- Flash Reaction Processes
- Fluid Flow and Heat Transfer in Submerged-Arc Slag-Cleaning Furnaces
- Thermodynamic Activities of Coppermaking Systems
- Rate Phenomena in the Flash Processing of Metal Dusts.

Respirable Dust

- Fracture Mechanics of Crack Propagation in Coal
- Mechanism of Lung Injury by Coal Mine Dusts
- Modelling of Longwall Face Ventilation
- Aerodynamic Diameter Analysis of Coal Dust
- Wetting Characteristics in Relation to Dust Abatement
- One-By-One Analysis of Coal Particles Using an Automated SEM with X-Ray Fluorescence
- Polymorphonuclear Leukocytes in Dust/Lung Interaction
- Dust/Lung Interaction in Coal Miners: Spirometry and Methacholine Challenge
- Biochemical Alterations in Mammalian Respiratory Mucus
- Dust Interaction with Nonhuman Primate Lungs
- Biologically Active Silica Using Photoacoustic Spectroscopy
- Analysis and Control of Diesel Particulates in an Underground Coal Mine
- Determination of Silica Particle Concentrations in Respirable Size Range.
- Morphometric Study of the Toxicity of Respirable Dust
- Release of Superoxide From Pulmonary Alveolar Macrophages

Respirable Dust (continued)

Tracheal Acoustic Impedance of Lung Air Passages
Knowledge-Based Expert System for Planning Mine Ventilation Systems
Dust Sampling and Analytical Strategies
Adhesion, Agglomeration, and Deposition of Respirable Dust
Augmentation of Dust Owing to Regrinding at the Face
Platelet-Activating Factor in the Etiology of Pneunmoconiosis

SECRETARY'S ADVISORY COMMITTEE ON
MINING AND MINERAL RESOURCES RESEARCH

The recommendations of this Advisory Committee, mandated by Public Law 98-409, are considered in the conduct of research and in the making of grants under this legislation. The Committee also is responsible for recommending the designation of new mineral institutes, for reviewing the eligibility of existing institutes and for preparing an annual National Plan for Research in Mining and Mineral Resources Research. At its September 30, 1987, meeting the Committee approved the 1987 grant award process, reviewed the research activities of the Respirable Dust Generic Mineral Technology Center, and drafted the 1987 update to the National Plan for Research in Mining and Mineral Resources. The Committee considered the question of continued eligibility of the Mineral Institutes based on their responses to a questionnaire that contained data on the extent to which individual Institutes met the four criteria of the Act. The Committee decided upon tentative standards relative to the criteria and established a procedure by which the Committee would make a final decision as to eligibility. The Committee also expressed its intention to review the utility and rationale for support of the present Generic Mineral Technology Centers and the possible need for new Centers.

90-486 O - 88 - 3

Appendix "C"

# Brief Biographies of Members of the Committee on Mining and Mineral Resources Research

Win Aung holds a Ph.D. and a M.S. in mechanical engineering from the University of Minnesota. He has been with the National Science Foundation since 1974 where he is currently Director of the Division of Mechanics, Structures, and Materials Engineering. From 1949-1974 he was a member of the Technical Staff of Bell Laboratories. He has also been Instructor, Department of Mechanical Engineering, at the University of Minnesota and is currently an adjunct professor at both Howard University and the University of Maryland. Prior to his graduate studies, he worked as an engineer with The Port Authority, Rangoon, Burma; Burma Oil Company; and Burma Oxygen Limited. He is a member of ASAE, ASME, and the American Society for Engineering Education. He has held visiting professorships at Chung Chung Institute of Technology, National Cheng Kung University, and National Taiwan University. He is a cofounder and member of the Executive Committee of the Pacific Institute of Thermal Engineering and was an editor of the Journal of Heat Transfer, Transactions of ASME. He has been a member and officer of numerous engineering, technical, and search committees and was chairman of the Organizing Committee, International Symposium on Cooling Technology for Electronic Equipment. He was first appointed to the Committee on January 24, 1987.

John C. Calhoun, Jr. is Emeritus Deputy Chancellor for Engineering of the Texas A&M University System. He has also served Texas A&M as Vice-President for Academic Affairs, Vice-Chancellor for Development, Dean of Engineering, Dean of Geosciences, Director of their Sea Grant College Program, Director of the Engineering Experiment Station and Director of the Texas Engineering Extension Service. From 1937 to 1946 and from 1950 to 1955 he was a faculty member at the Pennsylvania State University, attaining the rank of full professor and Head of the Department of Petroleum & Natural Gas. From 1946 to 1950 he was a faculty member at the University of Oklahoma and Chairman of the School of Petroleum Engineering. He holds a Ph.D. in petroleum and natural gas engineering from Penn State and an honorary doctorate from Ripon College. He is a member of the American Society of Engineering Education, the Society of Petroleum Engineers of AIME, and the Marine Technology Society, in each of which he is a past president. He has been Executive Director and President, Gulf Universities Research Corporation, Chairman of the Board of the University Corporation for Atmospheric Research, a Director of the Institute of Nautical Archeology and a member of the Texas Coastal and Marine Council. He was a member of the NAS/NRC Committee on Mineral Science and Technology and Chairman of the NAS Committee on Oceanography. He was Science Advisor, U.S. Department of Interior, 1965-67 and Acting Director of the Office of Water Resources Research in 1966. A member of the Presidential Task Force On Oceanography, he served as Chairman of the President's Santa Barbara Oil Spill Panel. He has served on numerous Federal Committees and Panels relating to technology, environment, and marine affairs. He is a member of the National Academy of Engineering. He was first appointed to the Committee on January 24, 1987.

John E. DeYoung, Jr. is Associate Chief of the U.S. Geological Survey's Office of Mineral Resources. Dr. DeYoung joined the USGS in 1973. During 1978-79, he served on the staff of the Policy Coordinating Committee for the Presidential Review of Federal Minerals Policy. He is Executive Secretary of the International Strategic Minerals Inventory, a cooperative project of the USGS, the U.S. Bureau of Mines, and seven other mineral-resource agencies from five other countries. He received a B.S.E. degree with honors in civil and geological engineering from Princeton University, a M.S. in economic geology from the University of Michigan, and a Ph.D. in mineral economics from The Pennsylvania State University. He was Distinguished Military Graduate from Princeton University Army ROTC and served on active duty as a field artillery officer at Fort Sill, Oklahoma, and Nha Trang, Vietnam. While in Vietnam he was awarded the Bronze Star Medal. Dr. DeYoung is a member of the Society of Mining Engineers of AIME, the Society of Economic Geologists, and Sigma Xi. He is a past chairman of the Washington, D.C., Section of AIME and of its Mineral Economics Subsection. In 1987, he received the Mineral Economist of the Year award from the Subsection. He was appointed to the Advisory Committee April 18, 1988.

Edward S. Frehling is a graduate of Massachusetts Institute of Technology with a major in metallurgy. He is President and Chief Executive Officer of Mountain States Chemical Enterprises, Inc., which is in the business of providing engineering and construction services relating to minerals processing for the mineral industry. During World War II, he served with the Corps of Engineers, U.S. Army, in Europe. Prior to founding his company in 1969, positions held includes Vice President and Manager of Business Development, Mining and Metallurgy Division, Parsons-Jurden Corporation; regional sales manager, Western Machinery Company; mill superintendent, St. Lawrence Fluorspar; plant metallurgist, Climax Molybdenum; and research engineer, Atomic Energy Commission. He is a recipient of the 1982 American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), Charles F. Rand Gold Medal, and is a recipient of an AIME Distinguished Member Award. He was President of the Development Authority for Tucson's Economy (D.A.T.E.) and a member of the Board of Directors of the Tucson Chamber of Commerce. He served as Vice President of the Arizona Council of Economic Education and as a Director of the United Bank of Arizona. Presently, he is a member of the Tucson Airport Authority, and serves on the University of Arizona Entrepreneurship Membership Committee and on the Board of Pima Community College Foundation. He is on the Industrial Advisory Council for the College of Engineering, the College of Business and Public Administration, and the Wildcat Club of the University of Arizona. He is also on the advisory board of Tucson Tomorrow. He is a director on numerous civic and business organizations including service as National President of the Associated Builders and Contractors. He is a co-founder of the Mining Club of the Southwest (Tucson). He was appointed to this Advisory Committee August 8, 1984.

Walter R. Hibbard, Jr. is a graduate of Wesleyan University and holds a doctorate in engineering from Yale University. He is a registered professional engineer in Connecticut, Virginia and Ohio. During the Second World War he served as Lieutenant in the U.S. Naval Reserve. He has been a University Professor of Engineering at Virginia Polytechnic Institute since 1974. Positions held prior to that include professor of engineering, Yale University; Manager, Metallurgical and Ceramics Research, General Electric Research Laboratory; Director, Bureau of Mines; and Vice President, Owens Corning Fiberglass Corporation. He has received honorary degrees from Yale, Michigan Technological University, and Montana College of Mineral Science and Technology and has served on numerous Governmental, university, and National Academy of Sciences committees. He has been president of The Metallurgical Society and of the American Institute of Mining, Metallurgical and Petroleum Engineers and is a recipient of the Koehler W. Raymond award and the James Douglas gold medal from the latter organization. He is a fellow of the American Academy of Arts and Sciences. A member of numerous professional and academic organizations, he is founding editor of the journal, Materials and Society. He was appointed to the Advisory Committee January 1, 1984.

Joseph E. Crowley holds a Ph.D. from the University of Washington, a masters degree from California State University and a B.A. from the University of Iowa. He has been President of the University of Nevada-Reno since 1978. He has been professor and chairman of the Department of Political Science at the University of Nevada and has served as a policy formulation officer for the Environmental Protection Agency. A member of the American Political Science Association, the Western Political Science Association, and the Northern California Political Science Association, he is author of the book "Democrats, Delegates, and Politics in Nevada: A Grassroots Chronicle of 1972," and a co-editor of the publication "Environment and Society." He was appointed to the Advisory Committee January 3, 1985.

Orme Lewis, Jr. is a graduate of the University of Arizona with a major in economics. He is Vice President of World Resources Company and Executive Vice President of Kellogg-Arizona, Inc., which companies and affiliates are in the business of reclaiming metals from waste solutions and sludges. He is also president of Applewhite Laflin & Lewis, a real estate investment and development firm. Mr. Lewis was elected twice to the Arizona State legislature, from which he resigned as Senate Majority Leader in 1969 to serve as Deputy Assistant Secretary for Public Land Management in the Department of the Interior. He is a member of the Arizona State Power Plant and Transmission Siting Committee, Arizona Energy Resources Association, Desert Botanical Gardens, National Parks and Conservation Association and the Sierra Conservancy. Mr. Lewis is a Director of the Arizona State University Foundation, Mae's Art Council, Phoenix Childrens Hospital, and Polycystic Kidney Research Foundation. He was first appointed to the Advisory Committee on March 15, 1982. He was elected cochair of the Committee October 15, 1986.

John D. Morgan holds B.S., M.S., Ph.D., and E.M. degrees in mining engineering from The Pennsylvania State University. He served as a Major in the Corps of Engineers, U.S. Army, in World War II and as a senior official of the National Security Resources Board, the Defense Production Administration, and the Office of Defense Mobilization in the Korean War period. He was a consultant to industry and government 1956-71, a member of the National Defense Executive Reserve for 30 years, and has been a senior official of the U.S. Bureau of Mines since 1971, having served as Acting Director for 3 years and currently as Chief Staff Officer. He is an Honorary Professor, Industrial College of the Armed Forces, National Defense University, a Distinguished Member of the Society of Mining Engineers-American Institute of Mining, Metallurgical, and Petroleum Engineers, a Fellow of the Society of American Military Engineers, and a member of the Scientific Research Society of America and the American Defense Preparedness Association (formerly Army Ordnance Association). In 1939-40 he served as a member of the National Academy of Sciences' Committee on the Scope and Conduct of Materials Research. He was also a member of the National Academy of Sciences' Committee on Mineral Science and Technology, 1965-1969, that made recommendations leading to the Mining and Minerals Policy Act of 1970 and the subsequent establishment of the State Mineral Institutes. Dr. Morgan has served as a member of the Advisory Committee since its establishment in 1978.

Carl L. Randolph is a graduate of Whittier College and holds masters and doctorate degrees in chemistry from the University of Southern California. He has served as a Lieutenant in the U.S. Naval Reserve. He is Vice Chairman of the Board of Directors of U.S. Borax and Chemical Corporation having served as President from 1969 to 1987. He has been a Director of the corporation since November 1968. Between 1963 and 1969, he served as Assistant to the President, Vice President of Marketing Development, and Executive Vice President of U.S. Borax and Chemical. Between 1957 and 1963, he served successively as Manager of Inorganic Borax Research, Associate Director of Chemical Research, Vice President, and Chairman of the Board of U.S. Borax Research Corporation, a subsidiary of United States Borax and Chemical. He was Principal Chemist with Aerojet General Corporation from 1949-1957. He is Chairman, Board of Trustees, Whittier College; Director, Potash Institute of North America; Director, Merchants and Manufacturers Association; and chairman of the American Mining Congress Mining and Minerals Policy Committee. He is also a member of the AMC Surface Mining Committee, the American Chemical Society, the Newcomen Society, and the Advisory Board of the Hawaiian Educational Council. He was appointed to the Advisory Committee June 4, 1986.

Don L. Warner received the professional degree of geological engineer in 1956 and the master of science degree in 1961 from the Colorado School of Mines and the Ph.D. degree in Engineering Science from the University of California at Berkeley in 1964. Since 1969, he has been professor of geological engineering at the University of Missouri-Rolla and became Dean of the School of Mines and Metallurgy in 1981. Prior to his appointment at the University of Missouri he was Chief of Earth Sciences for the Ohio Basin Region of the Federal Water Pollution Control Administration (1965-1969) and Research Geologist and Engineer for the Division of Water Supply and Pollution Control of the U.S. Public Health Service (1956-1965). He worked for several energy companies in the western U.S. and Central America during 1956-58. Since 1969, he has been consultant to numerous Governmental agencies, academic organizations and private companies. He is a member of the American Association of Petroleum Geologists, American Institute of Professional Geologists, Association of Engineering Geologists, Geological Society of America, National Water Well Association, National Society of Professional Engineers, and Missouri Society of Professional Engineers and is a registered professional engineer and certified professional geological scientist. He was appointed to the Advisory Committee January 3, 1985.

James W. Ziglar holds a B.A. from George Washington University and received his Juris Doctor from George Washington University National Law Center in 1972. He is a member of the Bar in Arizona, Virginia, New York and the District of Columbia. He is Assistant Secretary for Water and Science, U.S. Department of the Interior. Prior to his commission as Assistant Secretary, Mr. Ziglar was employed as Managing Director of the Municipal Investment Banking Department of Paine Webber. He also has been associated with Dillon, Read & Company, New York, as Senior Vice President of the Public Finance Department; O'Connor, Cavanagh, Anderson, Westover, Killingsworth & Beshears, Phoenix, Arizona, as Partner-in-Charge of the Public Finance Department; and Hodge Rowe Gentric Kleinman & Farnen, New York, as Associate Attorney in the Public Finance Department, before entering the financial services industry. Mr. Ziglar served as Law Clerk to Associate Justice Harry A. Blackmun of the United States Supreme Court. He also served as Special Assistant for Legislative and Public Affairs in the U.S. Department of Justice and as an aide to former Senator James G. Eastland. He is a Registered Municipal Securities Principal and has served on a number of the Board of Directors of the National Water Resources Association and as Chairman of its Financial Council. He was appointed cochair of the Advisory Committee on May 12, 1987.

# MINERAL INSTITUTE FUNDING
## Fiscal Years 1978-1987

| | |
|---|---|
| University of Alabama | 2,666,731 |
| University of Alaska | 2,018,987 |
| University of Arizona | 2,106,826 |
| University of California-Berkeley | 2,579,054 |
| Colorado School of Mines | 2,560,795 |
| Georgia Institute of Technology | 1,504,906 |
| University of Idaho | 2,722,453 |
| Southern Illinois University-Carbondale | 3,031,257 |
| Purdue University | 2,703,067 |
| Iowa State University | 1,565,281 |
| University of Kentucky | 2,976,936 |
| Louisiana State University | 1,393,710 |
| Massachusetts Institute of Technology | 2,815,028 |
| Michigan Technological University | 2,170,991 |
| University of Minnesota | 2,935,105 |
| University of Mississippi | 1,738,918 |
| University of Missouri | 4,273,601 |
| Montana College of Mineral Science & Tech. | 2,399,725 |
| University of Nevada-Reno | 3,882,798 |
| New Mexico Institute of Mining and Tech. | 2,666,148 |
| Columbia University | 207,830 |
| University of North Dakota | 1,517,728 |
| Ohio State University | 2,624,947 |
| University of Oklahoma | 1,720,366 |
| Pennsylvania State University | 6,737,033 |
| South Dakota School of Mines | 1,589,004 |
| University of Texas | 1,689,821 |
| University of Utah | 5,983,209 |
| Virginia Polytechnic Institute & State Univ. | 3,729,905 |
| University of Washington | 1,374,185 |
| West Virginia University | 5,589,556 |
| University of Wyoming | 1,523,406 |
| TOTAL | $ 84,999,307 |

Exhibit "D"

Senator MELCHER. What do you oppose in the bill?

Dr. MORGAN. Well, I guess we oppose the authorization of future funding.

Senator MELCHER. You do not want any funding?

Dr. MORGAN. That is the position of the Administration, yes.

Senator MELCHER. Was it zero budgeted in the budget?

Dr. MORGAN. We have zeroed it for several years running, and the current budget request is zero. Yes, sir.

Senator MELCHER. Well, is this not a program where it is two non-Federal dollars for each Federal dollar?

Dr. MORGAN. That is correct. For every 67 cents that they put up locally, they get 33 cents from the government—two for one.

Senator MELCHER. Do we have any other program that works that way?

Dr. MORGAN. I am not aware of any others in this specific area. On the other hand I point out that the two-for-one matching is for the allotment grants, whereas we put up 100 percent of the research money, and the Bureau of Mines has ample authority to make research grants and contracts under its own organic legislation. We would not need this legislation for that purpose.

Senator MELCHER. Well, how much have you been putting up lately?

Dr. MORGAN. Sir?

Senator MELCHER. How much have you been—what is in the budget for what you just spoke of? The Bureau of Mines doing some basic research.

Dr. MORGAN. This years budget request for 1989 for mineral institutes is zero, and the total Bureau of Mines budget request for 1989 is, I believe $127 million.

Senator MELCHER. And how much of that $127 million is for basic research?

Dr. MORGAN. None is specifically earmarked for university research, though the budget that is presently before the Congress which totals $127 million in round numbers does have in health and safety technology in round numbers $38 million and for minerals and materials science $23 million. And for——

Senator MELCHER. Is that basic research you are talking about?

Dr. MORGAN. That is research. Yes, sir.

Senator MELCHER. And who spends than money?

Dr. MORGAN. The Bureau would spend that. Some might conceivably go to universities, but probably not much.

Senator MELCHER. You spend it in-house?

Dr. MORGAN. Largely, yes sir.

Senator MELCHER. Well, largely can mean half or a little more than half, or——

Dr. MORGAN. Oh, most of that would be in-house because this is a smaller budget request than we have received in the past.

Senator MELCHER. Well, is any of it not going to be spent, any of this research money not going to be spent in-house?

Dr. MORGAN. Probably a small amount would be outside contracts, where we find that there is expertise outside the Bureau that we do not have.

We want to make the most efficient use of all of the resources available in the country.

Senator MELCHER. And that is not matched one dollar Federal and two dollars non-Federal? Or is it?

Dr. MORGAN. No, sir. If we make an outside contract, it would be 100 percent Federal money.

On the other hand, if we have a cooperative arrangement with industry, industry might put up either money or they might put up access to facilities which has some money equivalent.

If we were to do research in a metallurgical plant, for example, on a cooperative agreement, they are allowing the use of the metallurgical facility, the testing equipment, the labor and so forth——

Senator MELCHER. Well, Mr. Morgan, how much of that is going to be done, is what I am asking?

Dr. MORGAN. Now much of that could be done?

Senator MELCHER. Yes. In millions of dollars. How much are you going to put up that is going to be matched in kind?

Dr. MORGAN. I would have to supply that for the record, sir. We have not broken out the current budget.

[The information follows:]

Hearing before the Subcommittee on Mineral Resources
Development and Production of the
Committee on Energy and Natural Resources
United States Senate
on S. 2240
to reauthorize the State Mining and Mineral Resources
Research Institute Program
June 27, 1988

Dr. John Morgan, Chief Staff Officer
Bureau of Mines

Question: Does the Bureau of Mines have any research ongoing which is cost shared with industry?

Response: Effective research and transfer of the results from Bureau of Mines activities from the laboratory to the industrial or scientific user require communication, contact, and cooperation with such potential users. These activities occur at various stages of the research cycle. One mechanism used by the Bureau of Mines to achieve effective research development and technology transfer is cooperative cost shared research projects. This mechanism is highly important to the success of the research and to technology transfer as it allows Bureau engineers to test and adapt innovative mining and mineral processing technologies under operating conditions and scale with run-of-the-mine minerals.

To facilitate access to the broadest range of non-federal cooperation and cost sharing, the Bureau of Mines negotiates memoranda of agreement with potential industrial and scientific cooperators. These agreements spell out the contributions to be made by each party to the agreement, with the industrial or scientific cooperator making either cash contributions or in-kind donations of equipment, materials, services, and/or personnel.

Following are examples of the types of cooperative agreements and contributions being made by cooperators.

HEALTH, SAFETY, AND MINING TECHNOLOGY

Cooperator: CSE Corporation
Contribution: $173,372
Objective: The objective of this effort is to develop a person-wearable, self-contained self-rescuer. The cooperator, under contract with the Bureau, cost-shared the research and provided the breathing apparatus, design expertise, and facilities.

Cooperator: Chandler, Inc.
Contribution: $1,000,000
Objective: The objective of this cooperative agreement is to develop a new computer-based, remotely-controlled highwall mining and haulage system. The cooperator is providing mining equipment, the mine site in West Virginia, and operating personnel for the in-mining testing and evaluation of the complete system.

Cooperative: Coaltex, Inc.
Contribution: $3,000,000
Objective: The objective of this agreement is to investigate and evaluate sensing, measurement, and interpretative technology for the remote or autonomous guidance of highwall and underground coal extraction equipment. Coaltex will provide the basic mining equipment, mine test site in West Virginia, and personnel for the in-mine test and evaluation of this technology.

Cooperator: Eickhoff Corporation (West Germany)
Contribution: $1,264,000
Objective: The objective of this cooperative effort is to investigate the benefits of water jet assisted coal extraction techniques. A contract for an advanced longwall shearer was jointly supported by the Bureau and Eickhoff, and the technology was demonstrated in a West German mine.

Cooperator: Island Creek Corporation
Contribution: $100,000
Objective: The objective of this effort is to investigate and formulate control strategies which minimize the problems associated with deep and ultra-gassy coalbeds. This effort is particularly related to longwall mining. Island Creek's contribution involves the cost of man-power and equipment for the in-mine investigations in their mine located in Virginia.

## MINERALS AND MATERIALS SCIENCE

Cooperator: J. R. Simplot Company
Contribution: $30,000
Objective: To determine the feasibility of using column flotation, using BOM fine-bubble generator, to beneficiate finely ground fluorapatite from gangue. Cooperator allowed Bureau researchers access to their process streams to evaluate technology in their mill facility in Aston, WY.

Cooperator: Phelps-Dodge
Contribution: $500,000
Objective: To investigate more efficient, environmentally acceptable flotation procedures to process complex sulfide ores. Cooperator made major modifications to one of their process streams in the Chino Mill facility in New Mexico to allow the evaluation of new flotation technologies under actual production conditions.

Cooperator: American Consolidated Mining Company
Contribution: $50,000
Objective: To investigate BOM fine-bubble generator/column flotation technology in the beneficiation of copper-tungsten ore. Cooperator allowed Bureau researchers access to their process streams to evaluate technology in their mill facility in Utah.

Cooperator: Barrick Resources
Contribution: $120,000
Objective: To determine the applicability of specific BOM research results to recovery of gold values from finely ground carbon in pulp leach tails. Cooperator gave Bureau access to their mill facility in Utah and provided samples for experimental work.

Cooperator: Cominco American
Contribution: $75,000
Objective: To investigate the potential recovery of cobalt and nickel from Missouri lead ores. Cooperator allowed Bureau researchers complete access to their process streams to evaluate technology in their Magmont mill facility in Missouri. In addition, the company assisted in the construction and installation of the experimental equipment.

ENVIRONMENTAL TECHNOLOGY

Cooperator: Alaska Placer Miners
Contribution: $50,000 to $300,000 per Miner
Objective: To develop and transfer technology for the Dewatering of Effluent Placer Water at Mines in Alaska. Placer gold miners in Alaska are facing stringent State and Federal regulations on the quantity of suspended solids in mine discharge waters. A Bureau developed flocculation method may provide a solution to this problem by removing suspended particles to below discharge requirements. In cooperation with the State, this technology is being demonstrated using a mobile unit to a number of Alaskan miners under individual MOA's. The value of each facility varies greatly. For the Bureau to set-up equivalent field demonstrations, the estimated costs would be $50,000 to $300,000 per demonstration. The benefits of this work will be field proven technology that allows Alaskan placer mines to meet regulations and to continue to produce domestic gold.

Cooperator: American Electric Power Company (AEP)
Contribution: $200,000
Objective: To monitor hydrologic and surface effects of subsidence that is induced by longwall coal mining. This study is being conducted at AEP's Meigs No. 2 Mine in Ohio and the Bureau is obtaining data necessary for developing technology for mitigating the harmful effects caused by subsidence. AEP is contributing approximately $200,000 in indirect funds, $100,000 in personnel for locating survey rates, drilling bore holes, and gathering survey central data, and $100,000 for purchasing multi-point borehole extensometers used during the survey.

Cooperator: Horsehead Resource Development Company, Inc.
Contribution: $250,000
Objective: The Bureau is conducing fundamental research on the application of pyrometallurgical technologies, such as the flame reactor, to recovering the heavy metal content of certain mineral-bearing wastes. Horsehead Resource Development (HRD--formerly St. Joe Minerals Corporation) has spent over $10 million on flame reactor development including the construction of a commercial-sized reactor at their Monaca, Pennsylvania site. Since FY 1986, the Bureau has provided HRD with contract funds (including $564,000 in FY 1988) to demonstrate the technical and economic feasibility of flame smelting for recovering the zinc, cadmium, and lead values contained in electric arc furnace dust and to test the reactors capability in processing other heavy metal-contaminated wastes, such as electroplating sludges. During FY 1988, HRD will spend approximately $250,000 of their own funds as its cost-sharing commitment to this effort.

Senator MELCHER. This is basic research where for every Federal dollar there are two dollars more that have got to be put up by non-Federal entities.

It seems to me to be a fairly good buy. And it seems to me that this is a self-serving position that you are probably delegated to recite here. You do not want the budget money, you do not want it in the President's budget, because Congress is going to put it in there anyway.

So you get a cheap ride for, how much is it, $15 million? You do not have to show it, you know it is going to be appropriated anyway. It is going to be authorized. Or if it is not $15 million, $12 million will be authorized.

I thought maybe you were going to say that you did not want the increase. But you just do not want anything. I suggest that if you were running the shop you might have a little different testimony.

But I am just constrained to say this is an example where the Administration zero budgets something in order to hold their budget down, and then the President gets on the tube and says the Congress spends too much money.

And it seems to me that this is an area that to neglect would be a serious mistake. This is not something where you contract out, you just throw money out of the Treasury to some nebulous contractor as we seem to be finding out in the case of the Navy's Investigation of Pentagon spending.

This is a case where you put one Federal dollar out and if they are satisfied that there are two non-Federal dollars out there and that the overall goal is worthwhile, and contributes to our understanding of some of the problems of mining and minerals.

And the neglect of our basic industries over the past half a dozen years really bothers me and seems to me to be taking a terrible chance on what our future might be as to a solid producing country and an economy based on solid production.

I have no further comments to make, Dr. Morgan. I thank you for your testimony.

Senator Ford.

## STATEMENT OF HON. WENDELL H. FORD, U.S. SENATOR FROM KENTUCKY

Senator FORD. Thank you, Mr. Chairman. I have no questions except to say that I am going to support S. 2240, and the House bill which is substantially the same, H.R. 3977, is already over here as I understand it.

My concern is that very little research is being done. The minerals technology base that we have had will allow us to fall even further behind in production of minerals and we will be forced to depend, as we seem to be growing that direction, depend on foreign sources.

Just like the testimony we had on the energy program, that every administration has an energy program. This Administration has an energy program of dependence. And if we keep plugging on that road, we will have some real problems.

Mr. Chairman, I am pleased to be here with you this morning and to offer my support for this legislation. Thank you for the time.

Senator MELCHER. Thank you, Senator, and thank you, Dr. Morgan.

Our second and last witness is Dr. Richard A. Bajura, Vice Chairman, National Association of Mineral Institute Directors, and Director of the Energy and Water Research Center from West Virginia University.

He will be accompanied by George Fumich, consultant for the Energy and Water Research Center at West Virginia University.

**STATEMENT OF DR. RICHARD A. BAJURA, DIRECTOR, ENERGY AND WATER RESEARCH CENTER, WEST VIRGINIA UNIVERSITY, ACCOMPANIED BY GEORGE FUMICH, CONSULTANT, ENERGY AND WATER RESEARCH CENTER, WEST VIRGINIA UNIVERSITY**

Dr. BAJURA. Good morning. It is good to see both of you here.

For the record I am Dick Bajura. I am the Director of our Energy and Water Research Program at West Virginia University. I am serving as the Vice Chairman of the National Association of Mineral Institute Directors.

This morning I am accompanied by George Fumich, who currently works with us, but he previously served as the Dean of our College of Mineral and Energy Resources, and before that time was working in the fossil energy field with the Federal government. He is well-known in Washington circles and I am pleased to have him working with us.

I am here today to seek your support for reauthorization of the Mineral Institute's program. As was stated by Senator Ford, we are in a very poor position in this country with regard to minerals technology and we are falling behind to a situation of dependence.

It is our view that the universities can work very well with the Bureau of Mines in advancing technology. The Bureau of Mines research tends to be applications oriented. It solves immediate problems.

The universities focus on basic research and provide some of the long-range ideas and technology that we will need for our future. We believe that the Mineral Institute Program with the Bureau and the universities working hand in hand is a successful combination.

You have discussed some of the benefits of the program earlier this morning. I would like to cite four ways in which we feel this program benefits our country.

First, the universities can get to work closely with industry. And by working with industry we can transfer our basic ideas into applications that can provide new ideas and new products for industry.

This program serves the educational purposes of this nation to provide our future technologists. I stated a little bit earlier the idea of technology transfer, universities are involved very closely in transfer, and as you cited in your testimony aproximately 2,600 technical publications were made.

There were 5,000 students in round numbers who graduated, and each one of those students writes a thesis or a dissertation, which is also a technical publication of sorts that is reserved for posterity in library shelves.

I think we are all aware of the current situation in the mining programs in this country. We are currently falling to only 19 programs offering mining engineering. This past academic year we had 105 freshmen in mining engineering across the country.

I know this is a cycle that occurs every four years or so as the industry swings up and down. But think of the impact on our professors who could possibly be lured away to other more profitable positions.

I believe that the funding provided by this program enables them to stay on campus, to do research, to recruit graduate students, so that we can maintain both our student population, which will ensure future technologists, and our population of experts who are currently on the faculty.

The Mineral Institute Program is authorized at a level of $400,000 for the Allotment Program. We used to be running at about $150,000 a year for each Institute. But lately that funding has eroded to $136,000, $138,000 a year. So we see ourselves slipping.

But when the program first started in 1978, this $150,000 level was in 1978 dollars. Right now we need about $225,000 to counterbalance the effects of inflation so we could buy the same amount of research that we did when we first started the program.

Therefore, the Mineral Institute directors are recommending an allotment level of at least $225,000 for each Institute for this coming fiscal year.

The program authorizes $14 million for basic research under the Generic Centers Program. We currently have six generic technology centers.

We are recommending a level of funding of $5 million this year for the four basic centers, with the provision that we would like to institute a new center, $2.5 million for the Respiral Dust Program, which is an older program, and $1.6 million for the Minerals Institute Program which just began this past year.

We believe that this is an important program. We believe that the tying together of Institutions across the country enables us to utilize all the expertise we have in focusing on problems that are identified by the thematic areas of the center.

We have ideas, that is the Institute Directors have sat around the table discussing it. We do it at our annual meetings. And think there are other areas in which we should be investing money for Generic Centers.

Things such as artificial intelligence and computers as applied to mining, hydrometallurgy, materials handling, mining and excavation, and as we see in the House version of this bill a need for work in strategic minerals and critical minerals.

We believe that there is ample room for additional funding for the Generic Technology Centers, and would recommend your further consideration over our current budget request.

We also recommend that the Bureau of Mines be allocated $350,000 a year in administrative costs to help them run this pro-

gram. In my testimony I have attached a summary table which reflects the position taken by the Mineral Institute Directors.

We point out, as you have, that the Allotment Program is two for one in matching. We point out that taking the Allotment Program and the Generic Centers Program together, the entire program is about a one to one match in terms of non-Federal versus Federal dollars. And we feel this is a very favorable ratio.

We believe that this program is a necessary component of our national investment portfolio in minerals research. We urge your continued support and we are very appreciative of what you have done for us in the past.

I thank you, Mr. Chairman. I would be happy to answer any questions you might have.

[The prepared statement of Dr. Bajura follows:]

Statement of

Richard A. Bajura, Director
Energy and Water Research Center

George Fumich, Consultant
Energy and Water Research Center

West Virginia University
Morgantown, West Virginia

on

# Senate Bill 2240

To amend the Act to reauthorize the State Mining and Mineral Resources Research Institute Program, and for other purposes.

Submitted to

Subcommittee on Mineral Resources Development and Production
The Honorable John Melcher, Chair

Committee on Energy and Natural Resources
United States Senate

June 27, 1988

Statement of R. Bajura and G. Fumich

Good morning, Chairman Melcher, and Members of the Subcommittee.

By way of introduction, I am the Director of the West Virginia Mining and Mineral Resources Research Institute and Vice Chairman of the National Association of Mineral Institute Directors (NAMID). My colleague, George Fumich, is a former Dean of the College of Mineral and Energy Resources at West Virginia University and currently is a program consultant to the West Virginia University Energy and Water Research Center.

We appreciate your invitation to appear before the Subcommittee to testify on pending legislation for reauthorization of the State Mining and Mineral Resources Research Institute Program. We strongly support reauthorization of the Mineral Institutes.

Our testimony also includes selected excerpts from the statement presented before the House of Representatives on March 22, 1988 by Dr. Bruce Tippin, Chairman of NAMID, who could not be with us today.

## INTRODUCTION

Our nation is facing serious threats to our strategic defense and economic well-being due to the condition of our mineral industry. In recent years, this industry has declined through the closure of numerous mines. Companies, such as Anaconda, Duval, Republic Steel, and U.S. Steel, have been forced to lay off personnel and drastically reduce the number of plants in operation. In the past, the United States was the recognized leader in mining and mineral technology, but this leadership has eroded and our research capability has decreased substantially.

If we do not enhance and strengthen our mineral technology base, America will fall even further behind in the production of minerals, and will be forced to depend on foreign sources for raw materials. This dependence will be of critical concern in the area of strategic minerals which must be secured from countries whose leadership may not be friendly to the United States.

In the past, the mining industry has supported a modest amount of research through internal corporate groups, commercial testing laboratories, and, to a minor extent, universities. Mineral related support companies which manufacture mining equipment or chemicals, and engineering

firms which design facilities, also supported research and technology development programs. Today, however, corporate research groups are drastically reduced in size and funding, the number of commercial laboratories has reduced to a handful, and manufacturing and chemical companies have turned to other more profitable areas of research.

The Bureau of Mines and university researchers remain as the only viable base for developing new technology for the mining industry. The work of the Bureau of Mines is applications-oriented and provides answers to today's problems facing the mineral industry. University researchers conduct innovative and long range research while developing our future generation of mineral technologists. The combination of the Bureau of Mines and the Mineral Research Institutes is a balanced team which can successfully address our nation's present and future needs for technology development in the minerals industry.

## HISTORY OF MINERAL RESEARCH INSTITUTES

The MMRRI program was initially authorized in 1977 under PL 95-87, and was reauthorized in 1984 under PL 98-409. The program currently includes 32 Institutes, each located at a major college or university in their respective states. Each Institute receives funding from the MMRRI Program under an allotment grant. Most of the Institutes also participate in the directed research programs funded under the six generic technology centers which were established starting in 1982.

Approximately 800 faculty members participate annually in research projects supported under MMRRI grants. Over the past five years, approximately 5,000 students have earned advanced degrees with support from the Program. These students, for the most part, have written theses or dissertations on their research. In addition, approximately 2,500 technical papers have been written on these projects and have been distributed to industry over this same period.

## BENEFITS OF MMRRI PROGRAM

Federal money allocated under the MMRRI program allows each Institute to focus research efforts on specific problems critical to a state or region. Exploratory research projects and innovative ideas can be investigated as small seed projects to develop base-level information and demonstrate the feasibility of concepts. Once the merit of an idea is shown, support from industry is more likely to be obtained to develop the technology.

For example, at the Alabama MMRRI, a new faculty member was granted funds to use laser holographic techniques to study mine subsidence. This project was successful and attracted the interest of industry for a variety of mining and mineral applications.

In West Virginia, the MMRRI Program has supported the development of a longwall mining center of expertise. Other research funded under the respirable dust generic technology center has lead to new advances in understanding how coal worker's pneumonoconiosis is developed. This latter project is conducted in conjunction with Penn State University, the University of Minnesota, MIT, and Michigan Technological University. By forming teams of faculty from different institutions under the generic centers program, the research expertise of the nation can be focused on the solution of important mineral problems.

With the downturn in the minerals industry, enrollments in mining related programs has been severely curtailed. For institutions which base resource allocations on student populations, these effects have resulted in reduced funding for faculty and for equipment. Some programs have been closed. The MMRRI funding provides research support which helps to retain our faculty members who might otherwise leave for more attractive positions, enables institutions to be more state-of-the-art in laboratory facilities, and supports graduate students who will be our minerals specialists of the future.

## COST OF MMRRI PROGRAM

PL 98-409 authorized a level of $400,000 per institute for the annual allotment program. Recent allocations have only been around $140,000 per year. NAMID is recommending a funding allocation of $225,000 for each institute for FY 89. Today's $225,000 will only be approximately equal to the initial allocation of $150,000 in 1978 in terms of research buying power when the effects of inflation are considered.

We wish to stress that the MMRRI Program requires a two-for-one cost share on the part of each institute. Therefore, the $225,000 federal funding requested would attract an additional matching funding of $450,000 from each state. This cost sharing will result in an overall mineral research program of $21,600,000, for which the federal share is only $7,200,000. The cost benefits to the government and to the nation are highly favorable for this program.

PL 98-409 also authorizes a funding level of $14,000,000 for the generic centers research program. NAMID recommends funding of $9,100,000 for FY 89 for this part of the MMRRI program. This funding will support research in the areas of

mine systems design and ground control, comminution, mineral industry waste treatment and recovery, pyrometallurgy, respirable dust, and marine minerals technology. Our recommendation includes $1,000,000 for establishing a new generic center whose focus and membership will be determined by competition among the institutes. The competitive aspect of this program ensures that quality research will be funded that addresses problems of importance to the industry. By establishing new centers as technology is developed and areas of emphasis change, the generic technology centers program will ensure relevance of the research to current needs.

We recommend that administrative costs of $350,000 be allocated to the Bureau of Mines for FY 89 for the purpose of overseeing the MMRRI Program.

## SUMMARY

In conclusion, Mr. Chairman, we strongly urge reauthorization of the MMRRI Program and funding for FY 89 at the levels summarized on the attached table. We believe that this program is a necessary component of our national investment portfolio in mining and minerals research. The level of cost sharing by participating institutions, which approaches one-to-one for the overall program, shows the deep commitment of our universities to meet our national needs for technology and technologists, for energy and minerals independence, and for reducing our national balance of payments deficit.

We thank you for your interest in the MMRRI Program and appreciate the opportunity to appear today before the Subcommittee.

| Table of Funding Recommendations | | FY 89 |
|---|---|---|
| Allotment Program | | $ 7,200,000 |
| Generic Centers | | 9,100,000 |
| Mine Design | $1,000,000 | |
| Comminution | 1,000,000 | |
| Waste Treatment | 1,000,000 | |
| Pyrometallurgy | 1,000,000 | |
| Respirable Dust | 2,500,000 | |
| Marine Minerals | 1,600,000 | |
| (new center) | 1,000,000 | |
| Administration | | 350,000 |
| Federal Share | | $16,650,000 |
| Cost Sharing | | $14,400,000 |
| Total Program for FY 89 | | $31,050,000 |

Senator MELCHER. George, do you want to make a comment?

Mr. FUMICH. I just want to say it is a privilege and a pleasure to again appear before this particular Committee.

I consider you and Senator Ford not only knowledgable experts in both the minerals area but also the energy area, two areas that I think are really in critical condition today in this country.

Unfortunately, industry and government alike in many ways, when funds become scarce research is the area that is first cut down. This is true not only in the minerals industry but in other industries.

And thank God we have strong knowledgable professionals here up on the hill that are putting their figurative fingers in a dike and trying to keep this program going when we really need it badly.

Because, not only in the minerals industry but also in the energy industry right now many of the professionals are unemployed because of the recession that we have in both areas. And our critical mass is really low not only in the Bureau of Mines in these areas but also in the Department of Energy. We really need support to continue.

And again, I just want to say that I completely subscribe to your comments and again, thank you for the opportunity to comment.

Senator MELCHER. Thank you, George. Dr. Bajura, did I hear you right when you said 105?

Dr. BAJURA. That is correct, sir.

Senator MELCHER. Freshmen mining engineers.

Dr. BAJURA. In mining engineering programs.

Senator MELCHER. Where?

Dr. BAJURA. There are 19 institutions throughout the country that offer these programs. West Virginia University is one of them.

I do not know the numbers of our institution, but I believe that we have a rather large class. I know that Penn State has one person in their program. South Dakota State University has a few, maybe 10. And then there are other institutions. It does not take but a couple students at an institution to add up to the small number.

Senator MELCHER. The little bit of seed money that goes into this, it actually is divided 31 different ways. Is it not?

Dr. BAJURA. There are 32 institutes now, sir.

Senator MELCHER. I read somewhere 31.

Dr. BAJURA. Columbia University was added in the past year.

Senator MELCHER. Columbia.

Dr. BAJURA. Yes. In New York.

Senator MELCHER. Where you would hardly expect to find it. So there are 32 now?

Dr. BAJURA. That is correct.

Senator MELCHER. Well, I have no questions. I just encourage both of you to keep the faith, I guess. That is about what it amounts to.

Dr. BAJURA. We appreciate your support, sir.

Senator MELCHER. Senator Ford?

Senator FORD. Thank you, Mr. Chairman. Let me ask a question or two.

We have seen a reduction in employment, we have seen an increase of imports in the steel Industry and the closure of a good many mines. Can that be basically laid at the doorstep of lack of research and development, lack of encouragement in the institutions? Lack of encouragement as relates to professors, your teachers, interest by students?

Dr. BAJURA. I believe that we are failing behind in many of these areas because we have not produced the new kinds of technology that we need to compete.

Basic advances in, an example such as longwall mining where we are using highly capital-intensive equipment and we are requiring some advanced sensing instruments to make sure that we actually find the coal where we are looking for it.

This kind of work requires new technology which I believe can come from universities, especially as we talk about the avant-garde research. I don't think we are putting that much money into these programs.

Yes, this is an Allotment Program, and yes we are getting matching funds from the universities and from the states. But it is really a very small amount of money.

If you look at $130,000 as an allocation to an institution, if I were a professor and wanted to really get into a project area, $130,000 for the Allotment Program would be used up in one meaningful project, and in some cases that would not be enough if we wanted to talk about really getting into some high technology research.

What we are doing with our programs now is using this money to support seed projects, when we try to prove out an idea. But once an idea is proved out, if nobody follows through with additional funding to take this into the field and use it, it never gets to the marketplace.

Yet we are seeing our competitors across the ocean developing new technologies. We currently do not manufacture longwall mining equipment in this country. We purchased that from England and Germany. And I believe that the reason we are doing this is because they are much more advanced than we are. They are investing money in research and we are not.

Senator FORD. I find that to be basically so in all our areas of industry in this country.

We have new technology for enriching uranium, that is a new state of the art, and we have been five years ahead and now we may be two years ahead of the Japanese. And we sit here and put nothing into it and squabble over what we should do, we get $250 million a year from the Japanese to enrich their uranium.

At least we ought to move in that new direction, but we sit here and just kind of wring our hands and say, oh, they will ship it over here to us. And the loss of American jobs overseas continues through all facets, basically in research and new developments, new technology, and we do not want to move.

I remember one slogan, what is it, progress is our most important product. Well, if you do not do research and development you will have no progress.

You said in your statement that there was one item, I am not exactly sure which one it was, that is in the House bill should be in

the Senate bill. Are there any other items in the House bill that we should have in the Senate bill?

Dr. BAJURA. There is a difference between the House and Senate version on the length of time for the authorization.

I favor the Senate's version of recommending a $15 million instead of a $14 million limit on the Generic Centers Program.

I believe the two bills are essentially the same. The House bill adds a new section, Section 11, which addresses the question of Generic Centers and asks that some new Centers be formed.

I believe that the Allotment Program is important. I support it. I also believe the Generic Center Program is important but for a different reason, because it helps us to focus all of our activity on one particular topic. And that enables us to bring researchers from across the country to work on that program.

So I would like to see more of that. I believe that this kind of a program with responsible management, research management, will provide good results for the country.

Senator FORD. We are regional in nature, I think. The auto industry was having a few problems here a few years ago and a lot of parts of the country did not feel it because, like Detroit and St. Louis maybe, Louisville, the centers of assembly of automobiles and small trucks and so forth, many of the states did not feel the same type of problem West Virginia might feel as far as layoffs.

You look at U.S. Steel and others that are beginning to close mines and lay off people, there is effect there. You can look around this room this morning, your testimony has not drawn, it has very little sex appeal to it. It takes people like Senator Melcher to have an interest in this or it may not survive.

There will always be something that will draw more lobbyists from downtown knocking on our door, more interest then generated from back home to put pressure on us to say, no, we do not need that in that area, let us put it over here where it will get bigger headlines.

But we are beginning to get close to 50 percent dependent on oil. And the embargo we had back in, what, 1973 it was about 30 percent. If they turn the spigot off on us today, we would not have enough to keep our military afloat, let alone the industry of this country.

I am pleased that we have people like old Dr. Melcher who looks at items such as this and try to encourage the Congress to increase the funding rather than decrease it.

George, I am glad to see you, I am glad to know that you are still plugging away, even though you are not around this town as much as we would like to have seen you. Mr. Chairman, I have nothing further.

Dr. BAJURA. Mr. Chairman, if I may offer a few other items, I have with me a brochure that was put together by Professor Sendlein of the University of Kentucky, and I want to tell Mr. Ford that Mr. Sendlein is doing a good job for us.

I would submit this for the use of your Committee files. It talks about the different Institutes and the accomplishments that we have over these past five years. And if you are interested also I have a copy of testimony that Mr. Fumich and I presented before

the Senate Appropriations Committee last month that summarizes also some of our testimony. So I would make that available to you.

Senator MELCHER. We are glad to have that. We will make that part of the files.

I report to you from Montana that the platinum mine in the Stillwater is functioning very well, and there is a possibility of opening up another part of the same mineral deposit on the Stillwater side of the mountains, and the owners are thinking of opening up on the balder side of the mountains and getting the same mineral property. It looks very promising so far.

The situation at Butte is that on money, capital raised in London will provide for hiring Australians to go back underground in shafts, in the old mines and see, they believe they are going to take out enough silver and gold, which was just bypassed when the copper mining was in its heyday there. And that looks promising.

Why is it Australians? Because apparently they have equipment that can go into the, smaller equipment that can go into the mines, the old mines, and be profitable.

Also, the tailings of the, going back for several decades, quite a few decades, up to 80 and 90 years, will probably be reworked to get out the silver and the gold. The copper is gone, silver and gold and other minerals may make it worthwhile just to rework it again.

I mention all of this because with the improvement in prices in minerals that yes, indeed, there is a great deal of interest in pursuing it, these operations. That is encouraging to me.

But it also says we better continue to have the education necessary and the technology that is necessary to keep us in this condition that exists right now throughout the world, and be able to utilize the opportunities that are available for providing minerals that we need here and, of course, around the world.

Thank you both very much. I will make the testimony or letter from the American Mining Congress a part of the record immediately following your submissions. And we will leave the hearing record open for two weeks for any further letters, written material that anyone cares to make part of this hearing record.

We will send additional questions down to the Administration and the Bureau of Mines, and we will also make those answers to those questions part of this hearing record. Thank you both very much.

Dr. BAJURA. Thank you.

Senator MELCHER. The subcommittee is adjourned.

[Whereupon, at 11:07 a.m., the hearing was adjourned.]

# APPENDIX

## RESPONSES TO ADDITIONAL QUESTIONS

United States Department of the Interior

BUREAU OF MINES
2401 E STREET, NW.
WASHINGTON, D.C. 20241

August 9, 1988

Honorable John Melcher
Chairman, Subcommittee on Mineral Resources
Development and Production
Committee on Energy and Natural Resources
United States Senate
Washington, D.C. 20510-6150

Dear Mr. Chairman:

Enclosed are responses to the additional questions resulting from the legislative hearing on S. 2240, a bill to reauthorize the State Mining and Mineral Resources Institute Program, which you sent by letter dated June 27, 1988.

Please let us know if we can be of further assistance.

Sincerely,

T S Ary

Director

Enclosures

bcc:
Office of Congressional & Legislative Affairs, MS 6246, MIB
Assistant Secretary--Water & Science (3), MS 6640, MIB
Director's Reading File (2), MS 1000
Congressional Liaison, MS 1010
Chief Staff Officer, MS 1003
Chief, Office of Mineral Institutes, MS 1020
OMI FILE COPY, MS 1020

WBM:RAMunson:njb:7/7/88:RAM288:MELCHER
Rewritten:JMFanelli:njb:7/7/88
Retyped:JMFanelli:njb:8/3/88
Retyped:8/9/88

Question 1: Do you think the mineral institutes have made a significant contribution to mining and minerals technology?

- o If so, in what way?

Answer: To correctly answer this and the following questions, it is important to clarify the functions of the mineral institutes and how they fit into the general structure of State-supported university education and research. A university normally includes several colleges and/or schools, and the latter are further subdivided into departments. Many additional entities are created for specific purposes, among them "institutes" and/or "centers" designed to facilitate interdisciplinary (cross-department) research in specific areas. The 32 mineral institutes and the 7 Generic Mineral Technology Centers (GMTC) are entities created under Public Law 98-409 to administer and account for Federal funding distributed under that law. The allotment grants (authorized by Section 1 of Public Law 98-409) permit a very broad range of educational and research activities appropriate at the State level, while the research grants (authorized by Section 2 of Public Law 98-409) must be much more closely identified with specific research projects of broad and/or national application. The Office of Mineral Institutes of the Bureau of Mines keeps careful track of the monies involved in the Mineral Institute program per se, but has no authority to require reporting of other monies that are utilized outside of the Mineral Institute program for mineral related purposes by individual professors affiliated with various departments, schools, colleges, or State agencies. In most universities, such other funding is estimated to greatly exceed the annual Federal contributions to the Mineral Institutes program.

The Mineral Institute program has made many diverse contributions to mining and mineral technology. It must be remembered that the program stems directly from the 1969 recommendations of the Committee on Mineral Science and Technology of the National Academy of Sciences set forth in the publication "Mineral Science and Technology - Needs, Challenges and Opportunities." These recommendations were intended to call attention to the decline in education and research in this important area which, together with agriculture, forms the basis for our economy and our national security. The Mineral Institute program served to revive interest in this important area by universities, State governments, industry and the Federal Government. In the 10 years since 1977, the program has encouraged major additions to university physical facilities (which, however, were paid for by State or private sources) and to professional staffs engaged in mineral education and research. It has also supported the participation of hundreds of graduate students in recognized Masters and Doctors Degree programs. Numerous research

publications, wholly or partially funded under the Mineral Institute program, have been printed in the technical literature of which approximately 150 are deemed worthy of inclusion in the Bureau of Mines list of new publications.

Question 2: Please give examples of research undertaken at the mineral institutes that have led to applications in industry which have increased the availability of minerals and enhanced productivity of the mining industry.

Answer: Most improvements in mining and minerals technology are evolutionary year-by-year and draw upon worldwide experience which is transmitted through individuals and technical societies, transcending national borders. Consequently, it would be extremely difficult, if not impossible, to attribute significant contributions uniquely to the mineral institutes per se, which are not discrete entities but rather parts of major universities as described in the answer to Question 1 above. There are a few examples of research undertaken by the Mineral Institute program that can be cited as having led to specific applications in industry which may increase the availability of minerals and/or enhance the productivity of the mining industry. Perhaps the best example is the development of interactive online computerized controls for comminution (crushing and grinding) processes that have been pioneered by the Comminution Generic Mineral Technology Center at the University of Utah and from which has sprung a private corporation applying this technology to industry. Another example that may be cited is the development by the Pyrometallurgy Generic Mineral Technology Center at the University of Missouri/Rolla of computer software making available thermodynamics information basic to the design of pyrometallurgy processes. As of March 1988 the Pyrometallurgy GMTC had filled 187 requests for the software from United States addresses and 113 requests from foreign addresses.

Question 3: In your testimony you state that the majority of the support at the schools comes from non-Federal sources. You also state that over $97 million has been available to the program between 1977 and 1988.

- How much non-Federal funding has been available for the same period? Please break the number down between State and industrial funding.

Answer: As described in the answer to Question 1 above, there is no authority to determine support of mineral-related activities at schools having mineral institutes. All that we can specifically require is information as to the matching funds required by law. The Advisory Committee, in seeking to determine whether the mineral institutes met the eligibility criteria of Section 10(a)(3) of Public Law 98-409, did obtain information on industrial support. This information, however, is incomplete and not comparable for all the institutes. Nevertheless, on the basis of that and other information obtained earlier, it is likely that private and State support for minerals research and education at the 32 universities having mineral institutes exceeds funding for the Federal Bureau of Mines itself.

Question 4: Do all of the 32 institutes currently meet the eligibility requirements of current law?

Answer: Yes. The Advisory Committee reviewed the eligibility of each of the 32 institutions in 1987.

Question 5: What would be the effect on the current 32 institutes if funding were provided only for generic centers as you recommended?

- Do all 32 institutes now receive research funds through the generic centers as well as individual allotment grants?
- If not, which institutes do not receive research funds under Section (2) of current law?
- Please provide, for the record, a breakdown by type of funding (allotment grant, research funds, research funds through participation in research centers) for each institute for each of the past 10 years.

Answer: At the present time, all 32 mineral institutes receive allotment grants authorized by Section 1(a)(1) of Public Law 98-409, which are frequently used to support research projects. Each mineral institute may submit project proposals for the generic center program and many are successful in obtaining support. In FY 1987, 25 of the 32 mineral institutes received some support from a generic center. In FY 1988 we anticipate that 22 mineral institutes will participate in the generic center program. Prior to the Bureau of Mines assuming administrative responsibility for the program in 1982, institutes received allotment grants, research grants, and scholarship/fellowship

grants. Breakdown of the funding by grant type prior to 1982 is not available. Starting in 1982, only allotment grants and research grants were awarded. The amount of the allotment grant was $150,000 in FY's 1982, 1983, and 1984. The allotment was $147,000 in FY 1985, $142,000 in FY 1986, and $138,000 in FY 1987. The accompanying table lists total awards to each institution by year. The amount of research supported through generic mineral technology centers may be obtained by subtracting the amount of the allotment grant from the total award for each year. No funding in a given year indicates that the institution had not yet been designated a mineral institute.

Question 6. Does the Department believe any additional generic centers are needed?

- o If so, in what research areas?

Answer: The Advisory Committee has indicated that it intends to review the question of whether additional generic centers are needed. Possibilities that have been advanced include hydrometallurgy, fine particle science, beneficiation, in situ mining, and land reclamation. In the 1988 continuing resolution, the Congress directed the creation of two new generic centers, both of which have been started: Mine Land Reclamation, centered at West Virginia University, with affiliates at the Southern Illinois University and the University of North Dakota; and Marine Minerals Technology at the University of Mississippi and the University of Hawaii at Manoa.

Question 7: Please address H.R. 3977, as passed by the House.

- o Which provisions do the Department support, if any and why?

- o Which do the Department oppose?

Answer: In view of the continuing Federal budgetary deficits, the Administration cannot support H.R. 3977 as presently drafted. However, we would not oppose specific reauthorization of the centers of generic mineral technology and a continuation of the Advisory Committee. The current generic mineral technology areas provide broad-based research facilities and personnel that complement and supplement basic research critical to the Nation's economy and security. The legally authorized Advisory Committee now provides a useful focal point for review and recommendations on mining and mineral resources research, and, in the event of a national emergency, it could aid in mobilizing scientific resources in this important area. The allotment grant program is now sufficiently mature as to be sustained by the States and the private sector.

Mineral Institute Funding by Fiscal Year

| Mineral Institute | FY 1978 | FY 1979 | FY 1980 | FY 1981 | FY 1982 | FY 1983 | FY 1984 | Total |
|---|---|---|---|---|---|---|---|---|
| University of Alabama | 160,000 | 295,454 | 310,063 | 466,065 | 250,000 | 249,932 | 352,250 | 2,083,764 |
| University of Alaska | 270,000 | 169,637 | 136,041 | 199,665 | 250,002 | 216,667 | 200,000 | 1,442,012 |
| University of Arizona | 270,000 | 187,597 | 384,992 | 259,509 | 150,000 | 150,000 | 150,000 | 1,552,098 |
| University of California at Berkeley | 270,000 | 238,932 | 362,622 | 312,054 | 225,000 | 250,000 | 208,283 | 1,866,891 |
| Colorado School of Mines | 270,000 | 234,626 | 331,214 | 297,756 | 200,000 | 195,250 | 265,388 | 1,794,234 |
| Georgia Institute of Technology | -0- | -0- | 337,798 | 290,108 | 150,000 | 150,000 | 150,000 | 1,077,906 |
| University of Idaho | 270,000 | 178,922 | 132,156 | 150,000 | 410,048 | 350,000 | 408,826 | 1,899,952 |
| Southern Illinois University at Carbondale | 268,453 | 382,914 | 691,207 | 598,158 | 150,000 | 150,000 | 150,000 | 2,390,732 |
| Purdue University | -0- | -0- | 477,285 | 553,931 | 469,731 | 307,839 | 299,989 | 2,108,775 |
| Iowa State University | -0- | -0- | 320,948 | 217,333 | 300,000 | 150,000 | 150,000 | 1,138,281 |
| University of Kentucky | 270,000 | 305,013 | 462,036 | 459,597 | 249,999 | 249,996 | 200,000 | 2,196,641 |
| Louisiana State University | -0- | -0- | 342,510 | 174,200 | 150,000 | 150,000 | 150,000 | 966,710 |
| Massachusetts Institute of Technology | 270,000 | 162,700 | 309,683 | 343,944 | 150,000 | 350,000 | 495,000 | 2,081,327 |
| Michigan Technological University | -0- | 270,000 | 380,123 | 281,970 | 199,988 | 184,008 | 150,000 | 1,466,089 |
| University of Minnesota | 270,000 | 210,573 | 187,988 | 150,000 | 225,000 | 340,016 | 374,999 | 1,758,576 |
| University of Mississippi | 270,000 | 164,857 | 187,289 | 239,772 | 150,000 | 150,000 | 150,000 | 1,311,918 |
| University of Missouri | 270,000 | 165,999 | 292,806 | 270,725 | 669,965 | 542,161 | 372,227 | 2,583,883 |

Mineral Institute Funding by Fiscal Year

| Mineral Institute | FY 1978 | FY 1979 | FY 1980 | FY 1981 | FY 1982 | FY 1983 | FY 1984 | Total |
|---|---|---|---|---|---|---|---|---|
| Montana College of Mineral Science & Technology | 270,000 | 363,698 | 326,546 | 191,093 | 300,000 | 186,258 | 150,000 | 1,787,595 |
| University of Nevada | -0- | -0- | 372,336 | 282,705 | 710,270 | 402,742 | 722,200 | 2,490,253 |
| New Mexico Institute of Mining and Technology | 270,000 | 288,046 | 306,263 | 305,405 | 320,000 | 248,000 | 287,250 | 2,024,964 |
| University of North Dakota | -0- | -0- | 324,760 | 315,968 | 150,000 | 150,000 | 150,000 | 1,090,728 |
| Ohio State University | 269,992 | 371,983 | 229,105 | 302,834 | 353,970 | 150,000 | 150,000 | 1,827,884 |
| University of Oklahoma | 270,000 | 165,037 | 136,527 | 194,841 | 150,000 | 150,000 | 150,000 | 1,216,405 |
| Pennsylvania State University | 270,000 | 345,568 | 510,099 | 565,088 | 150,000 | 936,021 | 745,680 | 3,522,456 |
| South Dakota School of Mines | -0- | -0- | 341,970 | 198,034 | 150,000 | 150,000 | 150,000 | 990,004 |
| University of Texas | 270,000 | 159,761 | 126,577 | 184,213 | 150,000 | 150,000 | 150,000 | 1,190,551 |
| University of Utah | 270,000 | 318,813 | 333,086 | 330,606 | 1,129,987 | 696,742 | 776,254 | 3,855,488 |
| Virginia Polytechnic Institute & State University | -0- | -0- | 523,113 | 480,213 | 734,899 | 350,000 | 467,855 | 2,556,080 |
| University of Washington | -0- | -0- | 299,184 | 198,001 | 150,000 | 150,000 | 150,000 | 947,185 |
| West Virginia University | 270,000 | 190,080 | 203,221 | 264,812 | 150,000 | 887,963 | 755,483 | 2,721,559 |
| University of Wyoming | 270,000 | 129,536 | 96,870 | 150,000 | 150,000 | 150,000 | 150,000 | 1,096,406 |
| TOTAL FUNDING | 5,558,445 | 5,299,746 | 9,776,418 | 9,228,600 | 9,098,859 | 8,893,595 | 9,181,684 | 57,037,347 |

MINERAL INSTITUTE FUNDING HISTORY

| Mineral Institute | FY 1978-84 | FY 1985 | FY 1986 | FY 1987 | Total |
|---|---|---|---|---|---|
| University of Alabama | 2,083,764 | 203,727 | 191,798 | 187,442 | 2,666,731 |
| University of Alaska | 1,442,012 | 196,975 | 192,000 | 188,000 | 2,018,987 |
| University of Arizona | 1,552,098 | 147,000 | 220,179 | 187,549 | 2,106,826 |
| University of California-Berkeley | 1,866,891 | 300,163 | 202,000 | 210,000 | 2,579,054 |
| Colorado School of Mines | 1,794,234 | 241,946 | 259,234 | 265,381 | 2,560,795 |
| Georgia Institute of Technology | 1,077,906 | 147,000 | 142,000 | 138,000 | 1,504,906 |
| University of Idaho | 1,899,952 | 321,457 | 276,463 | 224,581 | 2,722,453 |
| Southern Illinois University-Carbondale | 2,390,732 | 222,332 | 196,702 | 221,491 | 3,031,257 |
| Purdue University | 2,108,775 | 181,294 | 230,000 | 182,998 | 2,703,067 |
| Iowa State University | 1,138,281 | 147,000 | 142,000 | 138,000 | 1,565,281 |
| University of Kentucky | 2,196,641 | 197,900 | 294,340 | 288,055 | 2,976,936 |
| Louisiana State University | 966,710 | 147,000 | 142,000 | 138,000 | 1,393,710 |
| Massachusetts Institute of Technology | 2,081,327 | 236,535 | 187,801 | 309,365 | 2,815,028 |
| Michigan Technological University | 1,466,089 | 187,084 | 251,434 | 266,384 | 2,170,991 |
| University of Minnesota | 1,758,576 | 280,700 | 475,788 | 420,041 | 2,935,105 |
| University of Mississippi | 1,311,918 | 147,000 | 142,000 | 138,000 | 1,738,918 |

MINERAL INSTITUTE FUNDING HISTORY

| Mineral Institute | FY 1978-84 | FY 1985 | FY 1986 | FY 1987 | Total |
|---|---|---|---|---|---|
| University of Missouri | 2,583,883 | 532,772 | 587,928 | 569,018 | 4,273,601 |
| Montana College of Mineral Science & Tech. | 1,787,595 | 237,000 | 185,207 | 189,923 | 2,399,725 |
| University of Nevada-Reno | 2,490,253 | 557,599 | 372,280 | 462,666 | 3,882,798 |
| New Mexico Institute of Mining and Tech. | 2,024,964 | 292,000 | 142,000 | 207,184 | 2,666,148 |
| Columbia University | -- | -- | -- | 207,830 | 207,830 |
| University of North Dakota | 1,090,728 | 147,000 | 142,000 | 138,000 | 1,517,728 |
| Ohio State University | 1,827,884 | 317,000 | 282,000 | 198,063 | 2,624,947 |
| University of Oklahoma | 1,216,405 | 147,000 | 166,657 | 190,304 | 1,720,366 |
| Pennsylvania State University | 3,522,456 | 761,182 | 1,137,290 | 1,316,105 | 6,737,033 |
| South Dakota School of Mines | 990,004 | 252,000 | 142,000 | 205,000 | 1,589,004 |
| University of Texas | 1,190,551 | 147,000 | 142,000 | 210,270 | 1,689,821 |
| University of Utah | 3,855,488 | 648,980 | 723,570 | 755,171 | 5,983,209 |
| Virginia Polytechnic Institute & State Univ. | 2,556,080 | 397,352 | 464,098 | 312,375 | 3,729,905 |
| University of Washington | 947,185 | 147,000 | 142,000 | 138,000 | 1,374,185 |
| West Virginia University | 2,721,559 | 674,558 | 1,120,025 | 1,073,414 | 5,589,556 |
| University of Wyoming | 1,096,406 | 147,000 | 142,000 | 138,000 | 1,523,406 |
| TOTALS | 57,037,347 | 8,710,556 | 9,436,794 | 9,814,610 | 84,999,307 |

RAM485:HISTORY:7/20/87

Energy and Water Research
**West Virginia University**
Office of the Director

July 9, 1988
sh:melsupp

Senator John Melcher
Chairman, Subcommittee on Mineral
Resources Development and Production
Committee on Energy and Natural Resources
United States Senate
SD-362 Dirksen Senate Office Building
Washington, DC 20510

Dear Senator Melcher,

In response to your request of June 27, I am submitting additional testimony on the topics you addressed. Dr. Bruce Tippin, Chairman of NAMID, and Dean Don Warner, Member of the Bureau of Mines Advisory Committee, have contributed to this effort.

We are pleased to have this opportunity to provide additional input to your deliberations on the renewal of the Mining and Mineral Resources Research Institutes program.

Sincerely,

R. A. Bajura

Richard A. Bajura
Vice Chairman, National
Association of Mineral
Institute Directors (NAMID)

CC: G. Fumich - WVU
B. Tippin - NAMID
D. Warner - Advisory Committee
P. Hughes - NASULGC

304 293-2867/8 P O Box 6064 Morgantown, WV 26506-6064

Response to

Additional Questions for the Record

for Dr. Richard A. Bajura

Mineral Institute Directors on S. 2240

June 27, 1988

(submitted July 11, 1988)

1. WHAT LEVEL OF NON-FEDERAL FUNDING WOULD BE AVAILABLE TO SUPPORT THE 32 MINERAL INSTITUTES IF FEDERAL FUNDING WERE NOT AVAILABLE?

The mineral institutes program is supported by a 2:1 match by the participating institutions. The matching funds can be any combination of institutional funds, state funds, or outside funding from industry or other state governments.

Much of the matching support for the program comes from the participating institutions in the form of dedicating faculty time for participation in the research and the waiver of indirect costs associated with sponsored research programs. Institutional support can only be provided if there is additional funding for graduate students, faculty time during summer months, and equipment and supplies.

Therefore, if federal support to the mineral institutes were to be withdrawn, the institutional resources would be dedicated to other assignments for the faculty. This resource would not then be available to the program. The only real dollars available would be from outside industrial funding or specific state allocations for research. Since the mining industry is on hard times at present, very little industrial funding is available to support the kind of long range, high risk projects which are conducted by the institutes.

For practical purposes, the amount of support for the basic research studies conducted under the mineral research institutes program would be less than 25% of the current level of the allotment grants. Considering that the allotment grants are the driving force for a program three times the dollar value of the allotments, the estimated funding which could be secured would support a program of less than 10% of the current level of effort under the present MRI program.

2. DO YOU AGREE WITH DR. MORGAN THAT THE ALLOTMENT GRANT PROGRAM IS SUFFICIENTLY MATURE TO BE SUSTAINED BY THE STATES AND THE PRIVATE SECTOR?

   DO YOU SUPPORT CONTINUED FEDERAL FUNDING OF THE ALLOTMENT GRANT PROGRAM?

Continuing with the case presented in response to question #1, we do not agree that the level of research supported by the allotment grant program could be sustained without federal funding. The federal funding attracts a match of twice the allotment level. This matching funding would not be available without the allotment grants. The long range mineral research conducted by the institutes would be reduced by an estimated 90% without the MRI program.

The Mineral Research Institute directors whole-heartedly support continued federal funding for this program. We believe it is in the national interests for preserving and strengthening our minerals independence and for providing our future minerals technologists who acquire advanced education under the program.

3. DOES THE MINERAL INSTITUTE DIRECTORS ASSOCIATION SUPPORT THE REQUIREMENT IN S. 2240 OF SUBJECTING THE INSTITUTES TO AN ELIGIBILITY REVIEW AT LEAST ONCE DURING THE REAUTHORIZATION PERIOD?

The MRI directors are ever mindful of the need to properly utilize the funding awarded under this program for mining and minerals research. We believe that strong institutes are required to complete these research projects. We believe that reviews such as specified in S. 2240 will themselves strengthen our programs. We therefore solidly support the review provision in the proposed legislation.

4. DOES THE ASSOCIATION BELIEVE ADDITIONAL GENERIC CENTERS ARE NEEDED? IF SO, IN WHAT AREAS?

The Mineral Institute Directors support the funding of focused research in several areas not currently addressed by the current generic centers program. Examples of areas which could be addressed by additional funding are:

hydrometallurgy
extractive metallurgy
artificial intelligence and expert systems
mining and excavation
solid/liquid separation technology
materials handling
mining equipment design

The Advisory Committee of the Bureau of Mines could be charged with overseeing the establishment of such research programs.

5. PLEASE ADDRESS H.R. 3977, AS PASSED BY THE HOUSE.

S.2240 and H.R. 3977 are alike in many respects. Some significant differences between these two bills are as follows:

a. H.R. 3977 proposes reauthorization for a period of four years, whereas, S. 2240 recommends five years.

b. H.R. 3977 recommends a funding maximum of $14 million for research grants, whereas, S. 2240 recommends a limit of $15 million.

c. H.R. 3977 formally designates the Bureau of Mines as the oversight agency within the Department of Interior.

d. H.R. 3977 recommends an administrative allocation of $350,000 for all allotment and research grant oversight.

e. S. 2240 recommends a review of eligibility of each institute in Section 10 of the 1984 act, whereas, H.R. 3977 recommends review as part of a new section (Section 11).

f. H.R. 3977 recommends the formation of additional generic centers, with a priority given to those institutes which are not currently participating in generic centers programs; a specific generic center on strategic and critical minerals is recommended; a recommendation is made to establish a mechanism to start new generic centers and phase out old ones which have fulfilled their mission. [Section 11].

The position of the Mineral Research Institute Directors on the issues cited above is summarized as follows:

A. On issues (a) and (b), the Directors favor the five year reauthorization and funding at the higher level of $15 million for research grants.

A five year reauthorization reduces the burden on Congress to review this program frequently. The Advisory Committee for the Bureau of Mines will keep Congress appraised of significant events.

The higher level for research grants would permit more money to be appropriated; however, Congress has yet to reach the $10 million limit of the current program. Therefore, the Directors would be happy to attain even the $14 million level of authorization.

B. On item (c), we are pleased to work with the Bureau of Mines and consider this provision to be a statement of current practice.

C. The allocation of $350,000 for administration is intended to prohibit the BOM from deducting an administrative fee, usually 6% of the award, from amounts appropriated for research. Examples are deductions of 6% from monies awarded to the Respirable Dust Center and the Marine Minerals Center. The Directors recognize the need for administrative expenses for the BOM to manage these programs, but are concerned that Congress may not be aware that the full allocations appropriated to the Institutes are not awarded for research.

The Directors favor the award of sufficient funds for administration of the program to the BOM. At the same time, the Directors also request that full appropriations be given to the institutes as awarded by Congress. H.R. 3977 addresses this issue. The BOM should be requested to comment on the adequacy of the funding proposed or suggest alternative methods which satisfy both of the goals stated above, especially with regard to full funding for the institutes.

D. On items (e) and (f), the Directors support the provisions to review the eligibility of the institutes and the management goals of ensuring that the money is well spent on generic centers which are accomplishing significant work to make the best use of the funding available, given the national priorities. We recommend that the Advisory Committee for the BOM be used as a resource to evaluate the merit of new generic centers and establish a mechanism for their start-up.

E. It is our understanding from testimony given by Dr. John Morgan of the Bureau of Mines that the BOM would support the continuation of the Advisory Committee and the research program. The support of the BOM for the Committee and the research grants clearly shows the value of these two programs to the national needs in mining and minerals research.

We further understand that the BOM does not support the allotment grant program. Our comments above address the need for allotment grants. We urge continuation of all three - the Advisory Committee, the research grants program, and the allotment grant program.

Richard A. Bajura
Energy and Water Research Center
West Virginia University
Morgantown, WV 26506-6064

sh:melsupp